JPL D-11719

Advanced Spaceborne Thermal Emission and Reflection Radiometer

ASTER
JAPAN/USA

Standard Data Product Specification

31 July 1996

Jet Propulsion Laboratory
California Institute of Technology

CHANGE LOG

Date	Author	Description of Change
15 Apr 94	Geller	Initial draft
27 Oct 94	Geller	Updated text; updated inputs; added details of contents
28 Feb 95	Geller	Revised text to reflect HDF usage; revised list of standard products; updated inputs and contents; added HDF datatype column to contents; U.S. products baselined
6 Apr 95	Geller	Updated abstracts with those from the forthcoming EOS Dataset Reference Handbook; updated contents
31 Jan 96	Geller	Revised text to remove reliance on Generic Header and Product-Specific header; updated inputs and contents
31 July 96	Geller	Added QA information; added unified Generic Header, updated product input dependencies and contents, changed format to MS Word

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1. Introduction

1.1 Purpose and Scope

The purpose of this document is to provide a complete specification for each ASTER standard data product. It includes information of direct importance to end users as well as to developers, including accuracy, units, resolution, the inputs needed to produce each product, the priorities of alternate input sources, and the contents of each product.

1.2 Document Organization

Section 1 contains introductory material explaining the purpose and scope of the document, information sources, and related material. Section 2 describes the overall structure of a data product and relates it to ECS standards. Section 3 introduces the product abstracts and describes the terminology used in Appendix A. Section 4 introduces the product input dependencies and describes the terminology used in Appendix B. Section 5 introduces the contents of the data products and describes the terminology used in Appendix C.

1.3 Change Control

Because these specifications are ultimately implemented in the software that generates the data products, and in the products themselves, changes may impact the ASTER Product Generation Systems in Japan and the U.S., as well as science users of the products. Consequently, change control is necessary so that the affected parties have the opportunity to assess the impact of any requested changes. The formality and degree of control will increase as this specification and the software implementing it matures.

1.4 Information Sources

The information in this document is derived from several sources. The primary sources are discussions with the U.S. algorithm and prototype developers and members of the ASTER PGS development team, and the U.S. Algorithm Theoretical Basis Documents, which contain a detailed discussion of each algorithm.

1.5 Applicable Documents

1.5.1 Controlling Documents

The documents listed below contain binding requirements on the ASTER Science Team.

EOS Science Plan (in prep)

ASTER Algorithm Theoretical Basis Documents

ASTER Project Implementation Agreement (PIA), Volume II -- Ground Data Systems (Draft)

ICD Between ECS and the ASTER Ground Data System, March 1996. Hughes Applied Information Systems. DID 209-CD-002-003

Release B SDPS Database Design and Database Schema Specification for The ECS Project. Hughes Applied Information Systems. DID 311-CD-008-001, August 1996.

1.5.2 Supporting Documents

The documents listed below contain important background information for understanding the ASTER requirements.

ASTER End-to-End Data System Concept Document. Jet Propulsion Laboratory, 13 Oct 1994 (JPL D-11199)

ASTER Product Generation System Operations Concept. Jet Propulsion Laboratory, 10 June 1993 (JPL D-11417)

HDF-EOS Primer for Version 1 of EOSDIS, April 1995. Hughes Applied Information Systems. DID 175-WP-001-001.

ECS Functional and Performance Requirements Specification. Hughes Applied Information Systems. DID 423-41-02, January 1996

EOSDIS Level 2 Requirements, Volume 3 -- Other Systems (GSFC 423)

EOSDIS Requirements, Level 0, Executive Summary. EOS Project, NASA Goddard Space Flight Center, 15 March 1988

EOSDIS Requirements, Level 1. EOS Project, NASA Goddard Space Flight Center, 15 June 1989

EOS Output Data Products and Input Requirements (3 vols; draft). ESDIS Science Office, GSFC. April 1995

Science and Data Processing Segment (SDPS) Requirements (final). Hughes Applied Information Systems. DID 304-CD-002-002, March 1995

Release B SDPS/CSMS Requirements Specification for the ECS Project. Hughes Applied Information Systems. DID 304-CD-005-001, October 1995

SDT Toolkit Primer for the ECS Project. Hughes Applied Information Systems, Doc #194-815-SI4-001, May 1995

SDT Toolkit User Guide. Hughes Applied Information Systems, Doc #333-CD-003-002, August 1995

2. Product Structure and Contents

ECS has defined a set of format and content requirements for EOS data products; all ASTER products conform to these requirements. In this section, the two primary components of these requirements--file structure and metadata--will be discussed.

2.1 File Structure

All EOS products must be in HDF-EOS format, i.e. Hierarchical Data Format with additional conventions and standards created for EOS. All access to a product by product generation software must be through the collection of write and read utilities that are delivered with the ECS software toolkit. While the HDF-EOS tools determine the physical format of each product, the ASTER team determines the structure of the data items within it.

It is simplistic, though perhaps useful, to think of products as consisting of a header that contains metadata, and a body that contains the retrieved parameters. The metadata describe various aspects of the product, such as its name and the date the data were acquired. Much of this metadata is also stored in the IMS and is available there to facilitate user searches.

2.2 Generic Header

The Generic Header is a standard set of metadata that is included in all ASTER products, regardless of product level. Such a header fulfills at least two purposes:

1. To provide a standard set of basic information to users of all ASTER products so that the products are characterized in a concise way and provide critical information. Standardization across all ASTER products allows a user familiar with one ASTER product to apply this knowledge to other ASTER products, thus promoting and facilitating their widespread use.

2. To standardize ASTER metadata so as to facilitate the design, development, and operation of the product catalogue and storage functions (e.g., DADS and IMS in Japan, Data Server in U.S.) of the Japan and U.S. ground systems.

The Generic Header satisfies the needs of two major categories of stakeholders. The first category is the science users, represented by the U.S. and Japan Science Team. The second category is the Data System, which is responsible for product generation, archival, retrieval, and related activities. This category is represented by ECS and the ASTER GDS.

The ASTER Generic Header appears in Table 2.1. It is based on the GDS document AG-S-E-0409-R03 (1996/7/12), the Level 1 Data Product Specification (Science Version, V2), and the ECS document DID 311 (311-CD-008-001, August, 1996). Specifics on format and details of content may be found for most items in these documents, though for a few fields the format and content are TBD.

Note: While mostly completed, this header is still under development and subject to change based on discussions between the ASTER GDS, ECS, the Japan Science Team, and the U.S. Science Team. Eventually, this SDPS will contain all format and details for each product.

Source	Field Name	Number of Parameters	Comments
ECS-M	Input Pointer		
ECS-M	Ancillary Input Pointers		
ECS-M	Browse Pointer		
GDS	ID of ASTER GDS data granule		From L1 spec. Needed?
ECS-M	Granule Pointer		
ECS-M	Processing History Pointer		App. B
	xAR ID list		Required to support subscriptions
ECS-O	Platform Short Name		Needed by Science Team
ECS-O	Sensor Short Name (= Instrument Short Name)		
ECS-M	Short Name		
ECS-M	Size MB ECS Data Granule		
ECS-M	Parameter Value		
ECS-M	Locality Value		
ECS-M	Vertical Spatial Domain Value		
ECS-M	Vertical Spatial Domain Type		
ECS-M	Orbit Number		
ECS-M	Equator Crossing Longitude		
ECS-M	Equator Crossing Time		
ECS-M	Equator Crossing Date		
ECS-M	Bounding Rectangle…		Consists of four fields, one per corner
ECS-M	Time of Day		
ECS-M	Calendar Date		
ECS-M	Future Review Date		App. B
ECS-M	Science Review Date		App. B
ECS-M	QA Percent Missing Data		For each band (TBR for L1)
ECS-M	QA Percent Out of Bounds Data		For each band (TBR for L1)
ECS-M	QA Percent Interpolated Data		For each band (TBR for L1)
ECS-M	Reprocessing Actual		
ECS-M	Reprocessing Planned		
ECS-M	PGE Version		
GDS	PGE Date Last Modified		
GDS	PGE Name		

Source	Field Name	Number of Parameters	Comments
GDS	PGE Identifier		
GDS	PGE Function		
GDS	ASTER Scene ID		
GDS	AOS Scene ID		
	Receiving Center		
	Processing Center		
	Generation Date and Time		Needed by Science Team
	Processing Level ID		
	Map Projection		
	Resampling Method		New--requested by U.S.
	Pointing Angles	3 per tel	
	Gain		Per band (VNIR, SWIR only)
	Bands Acquired (=Available Bands)		
	Bands Processed		
	Scene Corners Lat/lon		
	Scene Center Lat/Lon and Time		
	Quad Corners Lat/Lon		
	Geometric DB version	3	Includes version, date, comments
	Radiometric DB version	3	Includes version, date, comments
	Geometric Correction	5	For each band
	Radiometric Correction	2	For each band
	Units		For each band; New--requested by U.S.
	Units Conversion Coefficient (=Radiance Conversion Coefficient)		By band? (TBD)
	Image Information (= Image Data)	6	For each band; includes pixels per line, lines in frame, bytes per pixel, etc
	Image Statistics	6	For each band; includes max, min, etc
	Scene Cloud Coverage		The 1A cloud assessment, by scene
	Quadrant Cloud Coverage		The 1A cloud assessment, by quad
	Cloud Coverage Table		The 1A cloud assessment, by block
	SWIR Registration Quality	6 (TBR)	Includes number of measurements, average offset, etc
	TIR Registration Quality	6 (TBR)	Includes number of measurements, average offset, etc
	Parallax Correction Quality	2 (TBR)	
	ASTER Operation Mode		
	ASTER Observation Mode		
	Recurrent Cycle Number		
	Flying Direction		
	Solar Direction		
	Day/Night Flag		
	Ancillary Data…		The s/c ancillary data, including position, attitude, solar position, etc

Table 2-1. The ASTER Generic Header

KEY:

- ECS-O: ECS parameter, optional for granules
- ECS-M: ECS parameter, mandatory for ASTER granules
- Number of Parameters: Indicates the number of parameters that the field has as currently defined

2.3 Product Body

The product body contains the retrieved parameter and any other pixel-based information. The body may be viewed as a set of "data planes", where a plane contains data related to a particular instrument band (such as the emissivity for each band), or to all bands (such as the surface kinetic temperature). Data planes vary in size depending upon the telescope, and are stored as HDF Science Data Sets (arrays). The body may also contain various types of ancillary data that are not pixel-based, such as the filter profiles. These ancillary data can be stored as HDF Science Data Sets, Vdatas (tables) or other structures as appropriate.

2.4 Writing and Reading a Product

The toolkit contains calls that are to be used by the product generation software to write an item to the header. These calls take a "parameter = value" approach, and the name of the parameter as well as its value are passed to the utility in the call interface.

Product generation software will be able to read the header and body portions of a product (either an ASTER product or a product from some other EOS instrument) using a toolkit call. End users, such as a scientist who ordered an ASTER product, can use the EOS utility called EOSview on their workstation to view the product, or write their own data access tools. EOSview will allow the user to view the header information as well as the product body, though scientific data analysis will require more sophisticated tools, many of which will probably be available as COTS software such as IDL.

2.5 First QA Data Plane

Quality assessment (QA) information is stored in several places in each product, depending on the type of information. Granule-level information is stored in the Generic and Product-Specific headers, while pixel-level information is stored in the First and Second QA Data Planes. The First QA Data Plane is generic and is included in all higher-level products; it will be described in this section. The Second QA Data Plane contains product-specific information and is described for each product in Section 6.

The first QA data plane has the following overall structure:

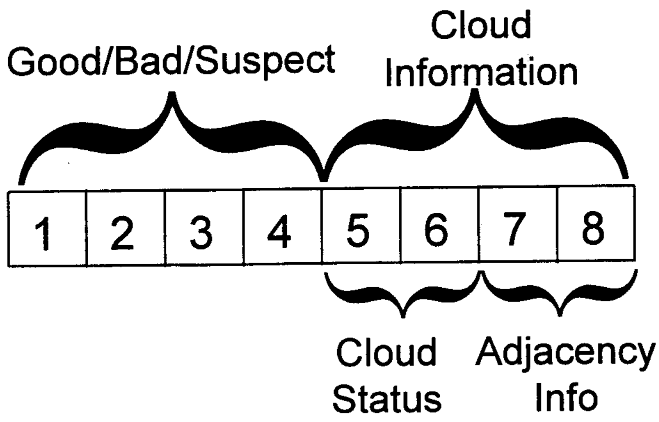

Figure 2-1. The First QA Data Plane

The good /bad/suspect pixel code field is four bits in length, occupying the most significant bits. It specifies, for each pixel, whether it is good, bad, or suspect, and perhaps why a bad or suspect determination was made. The meaning of each of the 16 possible bit patterns is explained in Table 2-2.

Category	Binary Code	Description
Bad	1111	Bad Pixel: This pixel has been labeled as Bad in the Level 1 data.
	TBD	General code, algorithm or LUT failure (All algorithms)
	TBD	Algorithm or LUT returns "bad input value" flag (All algorithms)
	TBD	Algorithm convergence failure (TES only)
	TBD	Algorithm divergence (TES only)
	TBD	Too few good bands (TES only)
	TBD	unassigned
	TBD	unassigned
Suspect	0111	Suspect Pixel: All bands of the input pixel are suspect
	TBD	Output Data value is Out-of-Range (All algorithms)
	TBD	Algorithm or LUT returned "suspect input value" flag (All algorithms)
	TBD	Edited DEM pixel (DEM only)
	TBD	Some TES output bands out-of-range (TES only)
	TBD	Perimeter effect from thick cloud
	TBD	Perimeter effect from thin cloud
Good	0000	Good Pixel: This pixel has no known defects.

Table 2-2. First four bits of the First QA Data Plane

The Cloud Status field is two bits in length, occupying the next two bits. This field specifies whether a pixel is clear, whether it is influenced by adjacent clouds, or whether it contains a thick or thin cloud (Table 2-3).

Binary	Description
10	Thick Cloud
01	Thin Cloud
00	Clear

Table 2-3. Cloud Stats pixel codes in the First QA Data Plane

The Cloud Adjacency effect field is two bits in length, occupying the least significant bits. It provides estimates of the distance from the center of the pixel to the influencing cloud(s). The bit assignments are presented in Table 2-4.

Binary	Description
11	Very Near (TBD to TBD m)
10	Fairly Far (TBD to TBD m)
01	Slightly Near (TBD to TBD m)
00	Far (TBD to TBD m)

Table 2-4. Cloud Adjacency pixel codes in the First QA Data Plane

Note: The Temperature Emissivity Separation Working Group will determine the appropriate TBD values for distance to the influencing cloud.

3. Data Product Descriptions

A summary of the attributes of the ASTER standard data products appears in Table 3-1. Following this is a data sheet on each product that includes an abstract and additional information.

The keywords used in Table 3-1 and the data sheets are described below. Most of these are based on those used by the EOS Science Processing Support Office; a complete listing may be found in the EOS Output Data Products and Input Requirements document, Appendix A.

Archival Method:

S--static, i.e., physically archived
V--virtual

Horizontal Coverage:

global--anywhere on the global surface
land--anywhere on the global land surface
polar--at latitudes greater than 60°N or S
/R--regional sites
/L--local sites

Production Mode:

on-request--produced for every requested scene
routine--.produced for every scene acquired

General:

N/A--Not applicable.

Product ID	Param Numb	Prod Level	Parameter Name	Lead Invest	Prod Mode	Units	Absolute Accuracy	Relative Accuracy	Horizontal Resolution	Horizontal Resolution	Size (MB)
AST01	3801	1A	Reconstructed, unprocessed instrument data	Tsu	routine	counts	TBS	TBS	15, 30, 90 m	global	125
AST03	2452	1B	Registered radiance at sensor	Tsu	cloud-free	W/m^2/sr/µm	2-4%	1%	15, 30, 90 m	global	125
AST06	2435	2	Decorrelation stretch--VNIR	Kahle	cloud-free	none	N/A	N/A	15 m	land/R,L	53
AST06	6103	2	Decorrelation stretch--SWIR	Kahle	cloud-free	none	N/A	N/A	30 m	land/R,L	13
AST06	2129	2	Decorrelation stretch--TIR	Kahle	cloud-free	none	N/A	N/A	90 m	land/R,L	1
AST04	4304	2	Brightness temperature	Kahle	on-request	C	1-2 C	0.3 C	90 m	global	6
AST07	2433	2	Surface reflectance	Slater	on-request	none	4%	1%	15, 30 m	land/R	238
AST09	2378	2	Surface radiance--VNIR, SWIR	Slater	on-request	W/m2/sr/µm	2%	1%	15, 30 m	land/R	238
AST09	3817	2	Surface radiance--TIR	Palluconi	on-request	W/m2/sr/µm	2%	1%	90 m	land/R	6
AST05	2124	2	Surface emissivity	Gillespie	on-request	none	0.05-0.1	0.005	90 m	land/R,L	6
AST08	3803	2	Surface kinetic temperature	Gillespie	on-request	K	1-4 K	0.3 K	90 m	land/R,L	2
AST13	3818	2	Polar surface and cloud classification	Ron Welch	on-request	none	3%	3%	15, 30, 90 m	polar/R,L	18
AST14	2828	4	Digital elevation model (DEM)	Roy Welch	on-request	m	>= 7 m	>= 10 m	15 m	land/R,L	35

NOTES
1) AST01 and AST03 are a Japanese responsibility
2) "cloud-free" means all those scenes that are adequately free of clouds
3) Size represents current best estimates
4) For DEMs, absolute accuracy implies ground control was used, relative accuracy implies it was not

Table 3-1. ASTER Standard Data Products

Reconstructed, unprocessed instrument data 3801

Product ID:	**AST01**	**Absolute Accuracy:**	**TBS**	**Production Mode:**	**routine**
Lead Investig:	**Tsu**	**Relative Accuracy:**	**TBS**	**Product Size (MB):**	**125**
Product Level:	**1A**	***Horizontal Resolution:***	**15, 30, 90 m**		
Units:	**counts**	**Horizontal Coverage:**	**global**		

Description

The ASTER level 1A raw data (AST01) are reconstructed, unprocessed instrument digital counts with ground resolution of 15 m, 30 m, and 90 m for 3 VNIR (0.5-0.9 um), 6 SWIR (1.5-2.5 um), and 5 TIR (8-12 um) channels. This product contains depacketized, demultiplexed, and realigned instrument image data with geometric correction coefficients and radiometric calibration coefficients appended but not applied. This includes correcting for SWIR parallax as well registration within and between telescopes. The ancillary, engineering data are also included. This product is the responsibility of Japan.

The radiometric calibration coefficients, consisting of offset and sensitivity information, are generated from a database for all detectors. The geometric correction is the coordinate transformation for band-to-band coregistration. Up to 777 scenes per day are collected, with each scene covering 60 km x 60 km area. These data are processed in Japan and sent to the US for further processing and archiving.

Algorithm Abstract

Depacketize, demultiplex and realign the CCSDS format raw data and append engineering information. Calculate the geometric and radiometric correction coefficients and append them to the data. This includes the correction for the misregistration within and between telescopes, and the conversion to a map projection.

Constraints

Registered radiance at sensor 2452

Product ID:	**AST03**	**Absolute Accuracy:**	**2-4%**	**Production Mode:**	**cloud-free**
Lead Investig:	**Tsu**	**Relative Accuracy:**	**1%**	**Product Size (MB):**	**125**
Product Level:	**1B**	**Horizontal Resolution:**	**15, 30, 90 m**		
Units:	**W/m^2/sr/µm**	**Horizontal Coverage:**	**global**		

Description

This product contains radiometrically calibrated and geometrically co-registered data for all ASTER channels, and is created by applying radiometric and geometric coefficients to the level 1A data. The bands have been co-registered both between and within telescopes, and the data have been resampled to apply the geometric corrections. As for the level 1A product, these level 1B radiances are generated at 15 m, 30 m, and 90 m resolutions corresponding to the VNIR, SWIR, and TIR channels. Calibrated, at-sensor radiances are given in W/m2/sr/um. This product serves as input to derived geophysical products.

Algorithm Abstract

The resampling method is user-selectable between Nearest Neighbor, Cubic Convolution, and Bilinear.

Constraints

Decorrelation stretch--VNIR 2435

Product ID:	**AST06**	**Absolute Accuracy:**	**N/A**	**Production Mode:**	**cloud-free**
Lead Investig:	**Kahle**	**Relative Accuracy:**	**N/A**	**Product Size (MB):**	**53**
Product Level:	**2**	**Horizontal Resolution:**	**15 m**		
Units:	**none**	**Horizontal Coverage:**	**land/R,L**		

Description

This parameter is a decorrelation stretched image of ASTER VNIR radiance data, color-enhanced by decorrelation of the color domain. The image is produced at pixel resolutions of 15 m for VNIR. Decorrelation-stretched images provide an overview that enhances reflectance and emissivity variations and subdues variations due to topography and temperature, respectively.

These images are used as a visual aid in reviewing the ASTER scene data and making the selection of suitable scenes for further analysis and research. In particular, a decorrelation-stretched image would show the potential user which scenes have spectral variations large enough to be useful for subsequent spectral analysis. In scenes with negligible spectral variation, the decorrelation stretch will produce images that appear noisy.

Algorithm Abstract

Calculate the principle components of a three band image. Stretch each component. Rotate back into RGB color space.

Constraints

The decorrelation stretch algorithm is best suited to the case where the input data of all three channels have a joint distribution that is Gaussian (or near Gaussian) in form. Fortunately the algorithm is fairly insensitive even to substantial deviations from the ideal. One should be aware, though, that if the distribution of the input pixels is strongly bimodal (or multimodal), the effectiveness of the decorrelation stretch is weakened, and there will be less diversity of color in this image than in other images. This can most easily occur when a substantial fraction of the scene consists of material that is unusually and very uniformly dark (or light), with the remainder of the scene composed of materials that are spectrally extremely different. Common examples of this would include scenes dominated by bodies of water or uniform vegetation cover, but with the remainder of the scene filled with materials that are in high contrast to the dominant material.

The decorrelation stretch is also limited in the sense that only three of the available channels are used to generate the output image. Information that is present only in a channel that has not been selected for input is lost to this product. Given the high degree of interchannel correlation, this will only rarely limit the quality of the output image. The channels selected for browse products will guarantee that if a given channel is not selected, at least one, and usually both of the adjacent channels will be selected.

Finally, the decorrelation stretch algorithm is a method of color enhancement that exploits whatever interchannel differences that may exist. Implicit in this technique is the assumption that the differences are real, and not noise or processing artifacts. The algorithm Single-mindedly produces a color enhanced output; if noise is a major component of the scene variation, the algorithm will enhance those noise differences to produce an output that, while colorful, will be painfully noisy.

Decorrelation stretch--SWIR 6103

Product ID: AST06
Lead Investig: Kahle
Product Level: 2
Units: none

Absolute Accuracy: N/A
Relative Accuracy: N/A
Horizontal Resolution: 30 m
Horizontal Coverage: land/R,L

Production Mode: cloud-free
Product Size (MB): 13

Description

This parameter is a decorrelation stretched image of ASTER SWIR radiance data, color-enhanced by decorrelation of the color domain. The image is produced at pixel resolutions of 30 m. Decorrelation-stretched images provide an overview that enhances reflectance and emissivity variations and subdues variations due to topography and temperature, respectively. The 2.165, 2.26, and 2.395 micrometer channels at 30 meter pixel spacing are routinely used, though the user may request as an on-demand product a decorrelation-stretched image generated from any three channels.

These images are used as a visual aid in reviewing the ASTER scene data and making the selection of suitable scenes for further analysis and research. In particular, a decorrelation-stretched image would show the potential user which scenes have spectral variations large enough to be useful for subsequent spectral analysis. In scenes with negligible spectral variation, the decorrelation stretch will produce images that appear noisy.

Algorithm Abstract

Calculate the principle components of a three band image. Stretch each component. Rotate back into RGB color space.

Constraints

The decorrelation stretch algorithm is best suited to the case where the input data of all three channels have a joint distribution that is Gaussian (or near Gaussian) in form. Fortunately the algorithm is fairly insensitive even to substantial deviations from the ideal. One should be aware, though, that if the distribution of the input pixels is strongly bimodal (or multimodal), the effectiveness of the decorrelation stretch is weakened, and there will be less diversity of color in this image than in other images. This can most easily occur when a substantial fraction of the scene consists of material that is unusually and very uniformly dark (or light), with the remainder of the scene composed of materials that are spectrally extremely different. Common examples of this would include scenes dominated by bodies of water or uniform vegetation cover, but with the remainder of the scene filled with materials that are in high contrast to the dominant material.

The decorrelation stretch is also limited in the sense that only three of the available channels are used to generate the output image. Information that is present only in a channel that has not been selected for input is lost to this product. Given the high degree of interchannel correlation, this will only rarely limit the quality of the output image. The channels selected for browse products will guarantee that if a given channel is not selected, at least one, and usually both of the adjacent channels will be selected.

Finally, the decorrelation stretch algorithm is a method of color enhancement that exploits whatever interchannel differences that may exist. Implicit in this technique is the assumption that the differences are real, and not noise or processing artifacts. The algorithm Single-mindedly produces a color enhanced output; if noise is a major component of the scene variation, the algorithm will enhance those noise differences to produce an output that, while colorful, will be painfully noisy.

Decorrelation stretch--TIR 2129

Product ID:	**AST06**	**Absolute Accuracy:**	**N/A**	**Production Mode:**	**cloud-free**
Lead Investig:	**Kahle**	**Relative Accuracy:**	**N/A**	**Product Size (MB):**	**1**
Product Level:	**2**	**Horizontal Resolution:**	**90 m**		
Units:	**none**	**Horizontal Coverage:**	**land/R,L**		

Description

This parameter contains a decorrelation stretched image of ASTER TIR radiance data, color-enhanced by decorrelation of the color domain. This image is produced at a pixel resolution of 90 m. Decorrelation-stretched images provide an overview that enhances reflectance and emissivity variations and subdues variations due to topography and temperature, respectively. The 8.3, 9.1, and 11.3 micrometer channels are routinely used, though the user may request as an on-demand product a decorrelation stretched image generated from any three TIR channels.

These images are used as a visual aid in reviewing the ASTER scene data and making the selection of suitable scenes for further analysis and research. In particular, a decorrelation-stretched image would show the potential user which scenes have spectral variations large enough to be useful for subsequent spectral analysis. In scenes with negligible spectral variation, the decorrelation stretch will produce images that appear noisy.

Algorithm Abstract

Calculate the principle components of a three band image. Stretch each component. Rotate back into RGB color space.

Constraints

The decorrelation stretch algorithm is best suited to the case where the input data of all three channels have a joint distribution that is Gaussian (or near Gaussian) in form. Fortunately the algorithm is fairly insensitive even to substantial deviations from the ideal. One should be aware, though, that if the distribution of the input pixels is strongly bimodal (or multimodal), the effectiveness of the decorrelation stretch is weakened, and there will be less diversity of color in this image than in other images. This can most easily occur when a substantial fraction of the scene consists of material that is unusually and very uniformly dark (or light), with the remainder of the scene composed of materials that are spectrally extremely different. Common examples of this would include scenes dominated by bodies of water or uniform vegetation cover, but with the remainder of the scene filled with materials that are in high contrast to the dominant material.

The decorrelation stretch is also limited in the sense that only three of the available channels are used to generate the output image. Information that is present only in a channel that has not been selected for input is lost to this product. Given the high degree of interchannel correlation, this will only rarely limit the quality of the output image. The channels selected for browse products will guarantee that if a given channel is not selected, at least one, and usually both of the adjacent channels will be selected.

Finally, the decorrelation stretch algorithm is a method of color enhancement that exploits whatever interchannel differences that may exist. Implicit in this technique is the assumption that the differences are real, and not noise or processing artifacts. The algorithm Single-mindedly produces a color enhanced output; if noise is a major component of the scene variation, the algorithm will enhance those noise differences to produce an output that, while colorful, will be painfully noisy.

Brightness temperature 4304

Product ID: AST04
Lead Investig: Kahle
Product Level: 2
Units: C

Absolute Accuracy: 1-2 C
Relative Accuracy: 0.3 C
Horizontal Resolution: 90 m
Horizontal Coverage: global

Production Mode: on-request
Product Size (MB): 6

Description

This Level 2 product includes brightness temperature in degrees Celsius (C) at 90 m resolution for ASTER's 5 thermal-infrared channels (8-12 um). This is an on-request product and will be generated only when requested. Brightness temperature is the apparent temperature of the surface assuming a surface emissivity of 1.0. Depending on whether the input data set has been atmospherically corrected this may be the brightness temperature either at the sensor or at the surface. Setting the emissivity to one is equivalent to assuming the target is a black body, so the brightness temperature is defined as the temperature a blackbody would be in order to produce the radiance perceived by the sensor.

Brightness temperature has been used to observe volcanic ash clouds, detect ice leads in the Arctic, and to identify anthropogenic and natural fires, to name a few examples. The ASTER brightness temperature will be used as an alternate to radiance in the temperature/emissivity separation algorithm to report relative cloudtop temperature because there will be no routinely available applicable atmospheric correction to enable a calculation of exact cloud-top temperature. ASTER brightness temperatures can be acquired during the day or night and over all surface types (land, water, cloud, etc.).

Algorithm Abstract

Two methods for determining brightness temperature have been evaluated. The first is to calculate the temperature using the center wavelength of a band with a simple inversion of the Planck function. The second involves using the temperature estimated with the center wavelength to calculate a new radiance value which is compared with the sensor radiance. The error in the new radiance is used to make another estimate at the temperature and the process iterated until the error becomes sufficiently small.

The radiance perceived by a sensor is a function of the radiation emitted from the target and the radiation emitted and absorbed by the intervening atmosphere integrated over the response function of the sensor. The radiation emitted from the target at a given wavelength is a function of its temperature and emissivity. Atmospheric effects are entirely ignored in the calculation of brightness temperature at the sensor, so we can say the radiance at the sensor is the integral over the response function of the emissivity times the blackbody radiance. The temperature and the spectral emissivity are the unknowns is this equation. If we set the emissivity to one, we can calculate the remaining unknown, the temperature. Setting the emissivity to one is equivalent to assuming the target is a black body, so the brightness temperature is defined as the temperature a blackbody would be at in order to produce the radiance perceived by the sensor.

Brightness temperature has been used to observe volcanic ash clouds and detect ice leads in the arctic, to name a few examples. One of its uses is as an alternate to radiance that is often more intuitively understood. It will be used in the temperature/emissivity separation algorithm to report relative cloudtop temperature because there will be no routinely available applicable atmospheric correction to enable a calculation of exact cloud-top temperature.

Constraints

None--the algorithm should work on TIR data acquired during the day or night and over land, clouds, water, or anything else.

Surface reflectance 2433

Product ID:	**AST07**	**Absolute Accuracy:**	**4%**	**Production Mode:**	**on-request**
Lead Investig:	**Slater**	**Relative Accuracy:**	**1%**	**Product Size (MB):**	**238**
Product Level:	**2**	**Horizontal Resolution:**	**15, 30 m**		
Units:	**none**	**Horizontal Coverage:**	**land/R**		

Description

The Level 2 surface reflectance data set (AST07) contains surface reflectance for VNIR and SWIR channels at 15 m and 30 m resolutions, respectively, after applying the atmospheric corrections to observed radiances. Data are recorded as percent reflectance. Accurate atmospheric correction removes effects of changes in satellite-sun geometry and atmospheric conditions and improves surface type classification and estimates of the Earth's radiation budget, and use of ASTER data for applications such as agricultural management requires atmospheric correction. Surface reflectance is calculated for clear sky scenes only. These atmospheric corrections, along with the corrections to other AM1 instruments, mark the first implementation of operational atmospheric correction in environmental satellites.

Algorithm Abstract

A radiative transfer code based on the well known Gauss-Seidel iteration approach is used to calculate the angular distribution of radiance in the atmosphere using the radiative transfer equation for a scattering and absorbing atmosphere. The atmosphere used in the code is divided into plane-parallel layers based on the spectral optical depth and a model atmosphere. The model atmosphere, currently the 1976 US Standard Atmosphere is used to describe the vertical distribution of scatterers and absorbing gases. The total and component optical depths are obtained from outside sources, for example MISR, MODIS, or climatological means. The scattering phase functions of the aerosol particles in the atmosphere are assumed to scatter as mie particles using an aerosol size distribution given by results from MISR or MODIS, or computed from the spectral optical depths. Noting that top-of-the-atmosphere radiance is nearly linear with surface reflectance, surface radiance is obtained by linearly interpolating between results of the radiative transfer code for several arbitrary surface reflectances. Both surface radiance and reflectance are obtained from this interpolation.

Results from this method will be in absolute radiance units of Wm-2µm-1sr-1 with an accuracy dependent upon the accuracy of total optical depths and surface slope. As stated the total optical depths will be obtained from outside sources with results from MISR and MODIS preferred. The model is expected to lose accuracy in terrain with high relief due to the assumption of horizontal homogeneity made in the flat- atmosphere model. Also because of this assumption, the model will give less accurate results in regions where the atmosphere or surface are not horizontally homogeneous on the scale of several pixels.

References:
B. M. Herman and S. R. Browning, 1965, A numerical solution to the equation of radiative transfer, J. Atmos. Sci., 22:559-566.

P. N. Slater, S. F. Biggar, T. G. Holm, R. D. Jackson, Y. Mao, M. S. Moran, J. M. Palmer, and B. Yuan, 1987, Reflectance- and radiance-based methods for the in-flight absolute calibration of multispectral sensors, Rem. Sens. Env., 22:11-37.

Constraints

This description applies to the atmospheric correction method used for the solar-reflective bands only. This algorithm requires a digital elevation model providing slope and elevation for accurate modeling of surface reflectance. The model requires total and component optical depths as input. VNIR - SWIR daytime only, SWIR may be available at night.

Surface radiance--VNIR, SWIR 2378

Product ID: AST09
Lead Investig: Slater
Product Level: 2
Units: W/m2/sr/µm

Absolute Accuracy: 2%
Relative Accuracy: 1%
Horizontal Resolution: 15, 30 m
Horizontal Coverage: land/R

Production Mode: on-request
Product Size (MB): 238

Description

This parameter contains surface radiance, in W/m2/sr/um, for VNIR and SWIR channels at 15 and 30 m resolutions, respectively. Atmospheric corrections have been applied to these radiances, and surface radiances are calculated for clear sky scenes. The surface radiance is only of known accuracy for cloud-free pixels since primary inputs (temperature and water vapor profiles) are only available for the cloud-free case.

Accurate atmospheric correction removes effects of changes in satellite-sun geometry and atmospheric conditions and improves surface type classification and estimates of the Earth's radiation budget, and use of ASTER data for applications such as agricultural management requires atmospheric correction. These atmospheric corrections, along with the corrections to other AM1 instruments, mark the first implementation of operational atmospheric correction in environmental satellites.

This parameter is generated only upon request. The VNIR data are available in the daytime only, SWIR data are collected in daytime, and in the cases of high temperature sources (e.g., volcanoes, fires) may be collected at night.

Algorithm Abstract

A radiative transfer code based on the well-known Gauss-Seidel iteration approach is used to calculate the angular distribution of radiance in the atmosphere using the radiative transfer equation for a scattering and absorbing atmosphere. The atmosphere used in the code is divided into plane-parallel layers based on the spectral optical depth and a model atmosphere. The model atmosphere, currently the 1976 US Standard Atmosphere is used to describe the vertical distribution of scatterers and absorbing gases. The total and component optical depths are obtained from outside sources, for example MISR, MODIS, or climatological means. The scattering phase functions of the aerosol particles in the atmosphere are assumed to scatter as mie particles using an aerosol size distribution given by results from MISR or MODIS, or computed from the spectral optical depths. Noting that top-of-the-atmosphere radiance is nearly linear with surface reflectance, surface radiance is obtained by linearly interpolating between results of the radiative transfer code for several arbitrary surface reflectances. Both surface radiance and reflectance are obtained from this interpolation.

Results from this method will be in absolute radiance units of Wm-2µm-1sr-1 with an accuracy dependent upon the accuracy of total optical depths and surface slope. As stated the total optical depths will be obtained from outside sources with results from MISR and MODIS preferred. The model is expected to lose accuracy in terrain with high relief due to the assumption of horizontal homogeneity made in the flat- atmosphere model. Also because of this assumption, the model will give less accurate results in regions where the atmosphere or surface are not horizontally homogeneous on the scale of several pixels.

References:
B. M. Herman and S. R. Browning, 1965, A numerical solution to the equation of radiative transfer, J. Atmos. Sci., 22:559-566.

P. N. Slater, S. F. Biggar, T. G. Holm, R. D. Jackson, Y. Mao, M. S. Moran, J. M. Palmer, and B. Yuan, 1987, Reflectance- and radiance-based methods for the in-flight absolute calibration of multispectral sensors, Rem. Sens. Env., 22:11-37.

Constraints

This description applies to the atmospheric correction method used for the solar-reflective bands only. This algorithm requires a digital elevation model providing slope and elevation for accurate modeling of surface reflectance. The model requires total and component optical depths as input. VNIR - SWIR daytime only, SWIR may be available at night.

Surface radiance--TIR 3817

Product ID:	**AST09**	**Absolute Accuracy:**	**2%**	**Production Mode:**	**on-request**
Lead Investig:	**Palluconi**	**Relative Accuracy:**	**1%**	**Product Size (MB):**	**6**
Product Level:	**2**	**Horizontal Resolution:**	**90 m**		
Units:	**W/m2/sr/µm**	**Horizontal Coverage:**	**land/R**		

Description

This parameter contains surface radiance, in W/m2/sr/um, for the TIR channels at 90 m resolution. Atmospheric corrections have been applied to these radiances, and surface radiances are calculated for clear sky scenes. It includes both surface emitted and surface reflected components. The surface radiance is only of known accuracy for cloud-free pixels since primary inputs (temperature and water vapor profiles) are only available for the cloud-free case.

Accurate atmospheric correction removes effects of changes in satellite-sun geometry and atmospheric conditions and improves surface type classification and estimates of the Earth's radiation budget, and use of ASTER data for applications such as agricultural management requires atmospheric correction. These atmospheric corrections, along with the corrections to other AM1 instruments, mark the first implementation of operational atmospheric correction in environmental satellites. This parameter is generated only upon request, and the data can be collected during either the daytime or nighttime.

Algorithm Abstract

The radiance measured by the ASTER instrument includes emission, absorption, and scattering by the constituents of the earth's atmosphere. The purpose of atmospheric correction is to remove these effects of the earth's atmosphere, providing estimates of the radiation emitted and reflected at the surface. Atmospheric correction is necessary to isolate those features of the observation that are intrinsic to the surface from those caused by the atmosphere.

The approach involves two fundamental elements: 1) the use of a radiation transfer model capable of estimating the magnitude of atmosphere emission, absorption, and scattering, and 2) the acquisition of all the necessary atmospheric parameters (temperature, water vapor, ozone aerosols) at the time and location of the measurement to be corrected. MODTRAN is the chosen radiation transfer model.

Constraints

The surface radiance is only of known accuracy for cloud-free pixels. The primary inputs (temperature and water vapor profiles) are only available for the cloud-free case. The ASTER Scene Classification product (AST10) can be used as a cloud mask as can the cloud identity products from MODIS and MISR. As this data product does not correct for the presence of water clouds it is of uncertain value when such clouds are present.

Surface emissivity 2124

Product ID:	**AST05**	**Absolute Accuracy:**	**0.05-0.1**	**Production Mode:**	**on-request**
Lead Investig:	**Gillespie**	**Relative Accuracy:**	**0.005**	**Product Size (MB):**	**6**
Product Level:	**2**	**Horizontal Resolution:**	**90 m**		
Units:	**none**	**Horizontal Coverage:**	**land/R,L**		

Description

The Level-2 land surface emissivity product contains surface emissivity at 90 m resolution generated only over the land from ASTER's five thermal infrared channels. Surface emissivity is required to derive land surface temperature (AST08) data, also at a resolution of 90 meters. The emissivity product is critical for deriving land surface temperatures. It is therefore important in studies of surface energy and water balance. The emissivity product is also useful for mapping geologic and land-cover features.

Current sensors provided only limited information useful for deriving surface emissivity and researchers currently are required to use emissivity surrogates such as land-cover type or vegetation index in making rough estimates of emissivity and hence land surface temperatures. The five thermal infrared channels of the ASTER instrument enable direct surface emissivity estimates. Mapping of thermal features from optical sensors such as Landsat and AVHRR has been used for many developmental studies. These instruments, however, lack the spectral coverage, resolution and radiometric accuracy that will be provided by the ASTER instrument.

Algorithm Abstract

Log each pixel and multiply all pixels in each band by the central wavelength of that band. Calculate the mean of each pixel. Subtract the mean value from the logged wavelength weighted value. Calculate the variance of the residual value. Plot the variance on a calibration curve to derive a mean emissivity value for the pixel. Use the mean to derive an emissivity value for the pixel in a given band. Use the emissivity value to calculate a temperature using Planck's Law.

Constraints

Currently there are no constraints, and the algorithm should work with TIR data acquired during the day or night. If a pixel is classified as "cloud" it is assumed no atmospheric correction will have been performed due to a lack of knowledge of cloud height, and the cloud pixel temperature will be given as the brightness temperature at sensor.

Surface kinetic temperature 3803

Product ID:	**AST08**	**Absolute Accuracy:**	**1-4 K**	**Production Mode:**	**on-request**
Lead Investig:	**Gillespie**	**Relative Accuracy:**	**0.3 K**	**Product Size (MB):**	**2**
Product Level:	**2**	**Horizontal Resolution:**	**90 m**		
Units:	**K**	**Horizontal Coverage:**	**land/R,L**		

Description

Land surface temperatures are determined from Planck's Law, using the emissivities from AST05 to scale the measured radiances after correction for atmospheric effects. Pixels classified as "cloud" will have no atmospheric correction due to a lack of knowledge of cloud height, and the cloud temperature will be given as the brightness temperature at sensor.

The derived land surface temperature has applications in studies of surface energy and water balance. Temperature data will be used in the monitoring and analysis of volcanic processes, day and night temperature data will be used to estimate thermal inertia, and thermal data will be used for high-resolution mapping of fires as a complement to MODIS global fire data.

Current sensors provided only limited information useful for deriving surface emissivity and researchers currently are required to use emissivity surrogates such as land-cover type or vegetation index in making rough estimates of emissivity and hence land surface temperatures. The five thermal infrared channels of the ASTER instrument enable direct surface emissivity estimates. Mapping of thermal features from optical sensors such as Landsat and AVHRR has been used for many developmental studies. These instruments, however, lack the spectral coverage, resolution and radiometric accuracy that will be provided by the ASTER instrument.

Algorithm Abstract

See product 2124, Surface Emissivity

Constraints

See product 2124, Surface Emissivity

Polar surface and cloud classification 3818

Product ID:	**AST13**	**Absolute Accuracy:**	**3%**	**Production Mode:**	**on-request**
Lead Investig:	**Ron Welch**	**Relative Accuracy:**	**3%**	**Product Size (MB):**	**18**
Product Level:	**2**	**Horizontal Resolution:**	**15, 30, 90 m**		
Units:	**none**	**Horizontal Coverage:**	**polar/R,L**		

Description

This Level 2 product is a polar classification map, consisting of the following classes: water, wet/slush ice, snow/ice, land, shadow, water cloud, and ice cloud. Each pixel is classified using a bit map for each of the above classes. Therefore, for complex scenes such as cirrus over broken sea ice, the water, ice and ice cloud bits would be set. This product is produced at 30 m spatial resolution and uses a combination of visible, near-infrared and infrared channels. The polar regions are defined as all land and water regions lying poleward to 60 N or 60 S. Both daytime and nighttime classifications will be available, with the daytime algorithm applied for solar zenith angles less then 85 degrees, and the nighttime algorithm applied in all cases. This is an on-request product.

Since greenhouse forcings are expected to be amplified in the polar regions, these regions may act as early warning indicators of global climate shifts. Cloud cover can be expected to be altered by greenhouse forcings, and cloud changes are expected to have a significant effect on sea ice conditions and regional ice-albedo feedback, especially to the polar heat balance which directly affects surface melting. ASTER polar data will be used to monitor changes in surface conditions, notably temperature, albedo, and sea ice breakup.

This data set builds on work over the past decade with data from LANDSAT TM, AVIRIS, TIMS, and MAS. The improved spectral coverage, resolution, and radiometric accuracy will enable ASTER to provide remotely sensed polar data of unprecedented accuracy.

The ASTER polar data set will also be used to validate the global-scale polar data and cloud property retrievals from MODIS. In particular, this data set will be used to validate the MODIS cloud optical thickness and effective particle sizes which directly impact the Earth's radiative budget. Only ASTER has the spatial resolution necessary to fully analyze the cloud 3-D effects.

Algorithm Abstract

The methodology implemented in this algorithm is a hierarchical or multi-stage classifier. The intent is to link several AI and other simple techniques in such a way that efficiency and speed are optimized. Some classes are classified at a higher level of confidence using a small set of spectral features using simple decision surfaces while others require larger feature sets (comprised of both spectral and textural measures) using more complex classification strategies such as fuzzy logic and neural networks. The algorithm has several stages. The first stage is where feature vectors close to class cluster centers are conservatively classified. Pixels not classified by the first stage are then passed to stages that use a fuzzy expert system and neural networks.

Constraints

The current algorithm is for daytime acquisitions only, where the solar zenith angle is less than 85 degrees.

Digital elevation model (DEM) 2828

Product ID:	**AST14**	**Absolute Accuracy:**	**>= 7 m**	**Production Mode:**	**on-request**
Lead Investig:	**Roy Welch**	**Relative Accuracy:**	**>= 10 m**	**Product Size (MB):**	**35**
Product Level:	**4**	**Horizontal Resolution:**	**15 m**		
Units:	**m**	**Horizontal Coverage:**	**land/R,L**		

Description

This data set contains topographic information derived from the along-track, 15 m ASTER optical stereo data acquired in the near infrared. These high spatial resolution DEMs (up to 7 m absolute horizontal and vertical accuracy with appropriate ground control, and up to 10 m relative accuracy without ground control) can be used to derive absolute slope and slope aspect good to 5 degrees over horizontal distances of more than 100 m. ASTER DEMs should meet 1:50,000 to 1:250,000 map accuracy standards.

This is an on-request product which will be generated by the Land Processes DAAC at EROS Data Center only when requested, and at a rate to be determined. Based on simulations of instrument operations, mission planning, cloud cover and illumination, the ASTER digital stereo data with a base/height ration of 0.6 should be acquired for all of the Earth's land surface below 85 degrees latitude by the end of the 5 year mission. These data are appropriate for users interested in generating DEMs themselves.

Topographic data as well as derived slope and slope aspect are basic to all aspects of land surface research including; cartography, climate modeling, biogeochemistry, biogeography, geophysics, geology, geomorphology and soil science. Digital elevation data are also required for atmospheric and radiometric correction of most satellite-acquired observations of the land surface. Digital elevation data are also used for practical engineering applications such as studies of drainage and runoff, and site suitability studies for buildings, waste containment sites, recreational areas, etc.

Generation of elevation models from stereo photographic data, now a routine adjunct to standard surveying methods, has been developed over the past 60 years based on the principles of photogrammetry. Extensions of these principles to the generation of DEMs from optical stereo satellite data had been implemented over the past two decades. Examples of these satellite stereo systems include SPOT, JERS-1 OPS, and MOMS. Currently, there are large areas of the globe for which no consistent, high-resolution, widely available elevation models exist. ASTER DEMs will help provide much needed coverage over many of these remote areas.

Algorithm Abstract

A conventional autocorrelation approach will be utilized to produce DEMs from the digital stereopairs.

Constraints

This product will be produced using off the shelf commercial software. Its accuracy will depend on whether the investigator is able to provide ground control points.

4. Data Product Input Dependencies

This section describes the elements of the Input Dependency list for each product, for which the information described below is provided.

NOTE: Scene Classification is included even though it is only an "interim" product (used as an input to one or more standard products).

Input Item. The input dependency being described.

Sources. Contains the source or sources (if several alternates exist) for the input item. If the source is an EOS product, the SPSO Parameter Number is shown.

Pri. Priority--the relative priority of each alternate source. The alternate source with the highest priority will be used first, but if it is unavailable the source with the next highest priority will be used, etc. An exception to this is when a user specifies a particular source at product order time.

Source Type. Several source types exist:

1. ASTER. The source is an ASTER standard data product.
2. ASTER PGS int. The source is a static table generated internally by the ASTER developers.
3. EOS AM1. The source is a standard product of one of the other instruments on the AM1 platform
4. EOS non-AM1. The source is a standard product for an EOS instrument on a platform other than AM1.
5. IDS. The source is an interdisciplinary science investigator.
6. non-EOS. The source is not an EOS instrument.
7. User-Supplied. The source is a user, who supplies information to be used at run time via a Data Product Request.

Product ID. The SPSO Product Identifier for the indicated source of the input item.

Parameter Name of Source. The official SPSO Parameter Name for the indicated source of the input item.

Input Dependencies for: Reconstructed, unprocessed instrument data 3801

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
See Level 1 Product Specification	.	0			

Comments:

Input Dependencies for: Registered radiance at sensor 2452

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
See Level 1 Product Specification	.	0			

Comments:

Input Dependencies for: Scene classification (Interim Product) 3804

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
ASTER Nominal Atmosphere	Gillespie		ASTER PGS int		
Comments: The climate-based atmosphere used for the approximate atmospheric correction that will occur when running in "D-stretch" mode.					
CASA model	TBS				
Comments: Helps quantify climate zone and season; used in conjunction with DEM to help determine scene characteristics.					
cloud mask	3660		EOS--AM1	MOD35	Classification masks. clouds/land/water/snow
Comments: Used as an aid in identifying cirrus clouds.					
DEM	EOS		EOS		
Comments:					
FIR filtering controls	Gillespie		ASTER PGS int		
Comments: Used to fine-tune the FIR filtering					
registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor
Comments: All bands, though TIR bands are not required--they only refine the analysis					
surface radiance TIR	3817		ASTER std	AST09	Surface radiance--TIR
Comments:					
surface radiance VNIR, SWIR	2378		ASTER std	AST09	Surface radiance--VNIR, SWIR
Comments:					
threshold values	AST		ASTER PGS int		
Comments: The classification thresholds					

Input Dependencies for: Decorrelation stretch--VNIR 2435

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
area of interest	user		user-supplied		

Comments: End users can specify a rectangular area within the scene to constrain the collection of statistics to that area. (Leads to 4 parameters)

bands	user		user-supplied		

Comments: End users have the option of specifying which three bands are to be used. (Leads to 3 parameters). If they do not choose any bands a set of bands chosen by the AST will be used by default. (Default bands are TBD but perhaps 1, 2, 3 for VNIR, 4, 6, 8 for SWIR, and 10, 12, and 14 for TIR.)

output mean and standard deviation	user		user-supplied		

Comments: End users can select the mean and standard deviation for the output bands. (Leads to 2 parameters)

registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor

Comments:

scene classification (coarse)	3804		ASTER int prod	AST10	Scene classification

Comments: Scene classification is generated as an interim product so that cloudy pixels can be identified and skipped during the collection of statistics. For the d-stretch, a crude but simple atmospheric correction is performed (compared to the scene classification approach used for the radiance and TES products).

skip factor for sampling	user		user-supplied		

Comments: End users can specify the "skip" factor to be used when collecting statistics (for example, every 10th pixel). (Leads to 1 parameter)

type of matrix	user		user-supplied		

Comments: End users can request that either a correlation or a covariance matrix be used to create the product. (Leads to 1 parameter)

Input Dependencies for: Decorrelation stretch--SWIR 6103

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
same as 2435	same as 2435				

Input Dependencies for: Decorrelation stretch--TIR 2129

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
same as 2435	same as 2435				

Input Dependencies for: Brightness temperature 4304

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
Brightness Temperature look-up table	AST		ASTER PGS int		
Comments: The look up table will be built once at the development site and delivered along with the code.					
Brightness Temperature look-up table	AST		ASTER PGS int		
Comments: Multiple versions will likely be necessary due to instrument drift.					
registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor
Comments: TIR only					

Input Dependencies for: Surface reflectance

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	2299	1	EOS--AM1	MIS05	Aerosol optical depth

Comments: The globally gridded versions of MIS05 (MIS08, MIS09) will be developed post-launch.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	2293	2	EOS--AM1	MOD04	Aerosol optical depth, spectral

Comments: Available over oceans, and perhaps for selected land areas (heavily vegetated).

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	SAGE	3			

Comments: Stratospheric aerosols (ASTER will try to use the same stratospheric aerosol information as is used by MISR)

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	climatology	4	ASTER PGS int		

Comments: In absence of MISR product over land, will develop a compendium of profiles (based on those provided with MODTRAN) as a function of time of year and geographic location.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol size distribution	1993	1	EOS--AM1	MIS05	MISR aerosol size distribution parameters, effective

Comments: Used to derive the Junge parameter. The globally gridded versions of MIS05 (MIS08, MIS09) will be developed post-launch.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol size distribution	1022	2	EOS--AM1	MOD04	MODIS aerosol size-distribution (radius-dispersion)

Comments: Available over oceans, and perhaps for selected land areas (heavily vegetated).

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol size distribution	climatology	3	ASTER PGS int		

Comments:

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
columnar ozone	SAGE	1	EOS--non AM1		

Comments: Launch planned for August 98, products available 6 to 9 months later. Note that ozone knowledge will not generally limit the accuracy of the atmospheric correction. Columnar values will be derived from profiles if needed.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
columnar ozone	TOMS	2	EOS--non AM1		

Comments: TOMS (Total Ozone Measurement System) measurements will not be coincident in space and time with ASTER measurements. Columnar values will be derived from profiles if needed.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
columnar ozone	1333	3	EOS--AM1	MOD07	O3 total burden

Comments: This MODIS product provides total burden.

columnar ozone	NMC	4	non-EOS		

Comments: This is a file that NMC produces but does not currently put on their NIC server as it is not a current operational product. Columnar values will be derived from profiles if needed.

columnar ozone	climatology	5	ASTER PGS int		

Comments: Source of this would be TOMS, SBUV, and SAGE.

columnar water vapor	3727	1	EOS--AM1	MOD30	Water vapor profile

Comments: This MODIS product uses NMC forecast data (which itself is an alternative input) as an initial condition for an iterative solution. Columnar values will be derived from profiles if needed.

columnar water vapor	3725	2	EOS--AM1	MOD38	Water vapor, atmospheric (thermal IR)

Comments: This product provides an overall estimate of the amount of water in the column; uncertainty is >20% or 5 mm. It can be used as a basis for developing a profile.

columnar water vapor	NMC	3	non-EOS		

Comments: This is an operational weather forecast system and could provide profiles coincident with receipt of raw ASTER data. It would be used only if no MODIS data were available. The dataset needed is the "Global Analysis and Forecast System, 1.0 x 1.0 degree resolution", as described by Frank Huang. The files are generically named "gdas1.TxxZ.PGrbF00", where xx = 00, 06, 12, or 18. The files are found at the NMC ftp site ftp://nic.fb4.noaa.gov/pub/fnl/. Columnar values will be derived from profiles if needed.

columnar water vapor	DAO GEOS	4	IDS		

Comments: This is the Goddard Data Assimilation Office system. Columnar values will be derived from profiles if needed.

columnar water vapor	climatology	5	ASTER PGS int		

Comments: This would come from an internal, climate-based model accounting for latitude, longitude, and season based on profiles associated with MODTRAN.

DEM	EOS		non-EOS		

Comments: High resolution needed to determine slope, low resolution for surface elevation. The DEM will be derived from DCW and DMA DTED. ETOPO5 will be used if a higher spatial resolution EOS DEM is not available.

Input Dependencies for: Surface reflectance 2433

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
look-up table	algorithm developer		ASTER PGS int		

Comments: The 10GB look up table.

look-up table version	user		user-supplied		

Comments: The end user can request a specific version of the Look Up Table (LUT).

MISR APOPP (aux. info for MISR05)	MISR SCF		EOS--AM1		

Comments: The Aerosol Physical and Optical Properties Product is generated once, at the MISR SCF, and updated infrequently. It is used for interpretation of the aerosol data contained in MISR05.

MODTRAN version	AST		ASTER PGS int		

Comments: Unlike TIR, for VNIR/SWIR, the end user can NOT request a specific version of MODTRAN. However the version is still an input so that the AST has the needed flexibility. As new versions of MODTRAN become available they will be evaluated for their suitability using factors such as accuracy and speed.

optical filter profiles	AST		ASTER PGS int		

Comments: These are used internally and are derived from pre-launch measurements.

pressure profile	NMC	1	non-EOS		

Comments: NMC profiles are based on pressure, and the pressure profile may be needed to convert from profiles to columnar values. The geopotential height parameter relates pressure to elevation, thus providing a profile. The dataset needed is the "Global Analysis and Forecast System, 1.0 x 1.0 degree resolution", as described by Frank Huang. The files are generically named "gdas1.TxxZ.PGrbF00", where xx = 00, 06, 12, or 18. The files are found at the NMC ftp site ftp://nic.fb4.noaa.gov/pub/fnl/.

pressure profile	DAO GEOS	2	IDS		

Comments: This is the Goddard Data Assimilation Office system.. The pressure profile may be needed to convert from profiles to columnar values.

pressure profile	climatology	3	ASTER PGS int		

Comments: Profiles taken from standards in MODTRAN. The pressure profile may be needed to convert from profiles to columnar values.

registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor

Comments: VNIR, SWIR only

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
requested source for aerosol optical depth	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for DEM	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for molecular optical	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for ozone	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for single scatter albedo	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for the junge parameter	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for the pressure profile	user		user-supplied		
Comments: The end user can request a specific source, if available.					
requested source for water vapor	user		user-supplied		
Comments: The end user can request a specific source, if available.					
scene classification (fine)	3804		EOS--AM1	AST10	Scene classification
Comments: If requested by a user, a cloud mask generated by the scene classification algorithm will be appended to the product. To generate this mask the algorithm will use the high-quality atmospheric correction information available from the surface radiance/reflectance products.					
single-scatter albedo	2334	1	EOS--AM1	MIS05	MISR single-scattering albedo, effective
Comments: MIS05 is the level 2 aerosol/surface product. The single scatter albedo can be extracted from it in conjunction with the MISR APOPP.					
single-scatter albedo	climatology	2	ASTER PGS int		
Comments: Aerosol property.					

Input Dependencies for:Surface radiance--VNIR, SWIR 2378

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
same as 2433--surface reflectance	see 2433				

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	2299	1	EOS--AM1	MIS05	Aerosol optical depth

Comments: [An aerosol profile will be inferred from the optical depth. Note that the MISR O.D. is for a rather different wavelength than that needed.] Also note that aerosol knowledge will not often limit the accuracy of the correction, except after a volcanic eruption. Includes model particle type, size distribution, and stratosphere aerosol assumptions.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	2293	2	EOS--AM1	MOD04	Aerosol optical depth, spectral

Comments: Available over oceans

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	SAGE	3	non-EOS		

Comments: Stratospheric aerosols (ASTER will try to use the same stratospheric aerosol information as is used by MISR)

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
aerosol optical depth	climatology	4	ASTER PGS int		

Comments: In absence of MISR product over land, will develop a compendium of profiles (based on those provided with MODTRAN) as a function of time of year and geographic location.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
DEM	EOS				

Comments: Used for path length. The DEM will be derived from DCW and DMA DTED. ETOPO5 will be used if a higher spatial resolution EOS DEM is not available.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
MODTRAN version	user				

Comments: The end user can request a specific version of MODTRAN. As new versions of MODTRAN become available they will be evaluated for their suitability using factors such as accuracy and speed.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
optical filter profiles	AST		ASTER PGS int		

Comments: These are used internally and are derived from pre-launch measurements.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
ozone profile	1333	1	EOS--AM1	MOD07	O3 total burden

Comments: This MODIS product provides total burden.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
ozone profile	SAGE	2	EOS--non AM1		

Comments: Launch planned for August 98, products available 6 to 9 months later. Note that ozone knowledge will not generally limit the accuracy of the atmospheric correction for TIR.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
ozone profile	TOMS	3	EOS--non AM1		

Comments: TOMS (Total Ozone Measurement System) measurements will not be coincident in space and time with ASTER measurements.

ozone profile	NMC	4	non-EOS		

Comments: This is a file that NMC produces but does not currently put on their NIC server as it is not a current operational product.

ozone profile	climatology	5	ASTER PGS int		

Comments: Source of this would be TOMS, SBUV, and SAGE

pressure profile	NMC	1	non-EOS		

Comments: NMC profiles are based on pressure. The geopotential height parameter relates pressure to elevation, thus providing a profile. The dataset needed is the "Global Analysis and Forecast System, 1.0 x 1.0 degree resolution", as described by Frank Huang. The files are generically named "gdas1.TxxZ.PGrbF00", where xx = 00, 06, 12, or 18. The files are found at the NMC ftp site ftp://nic.fb4.noaa.gov/pub/fnl/.

pressure profile	DAO GEOS	2	IDS		

Comments: This is the Goddard Data Assimilation Office system.

pressure profile	climatology	3	ASTER PGS int		

Comments: Profiles taken from standards in MODTRAN.

registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor

Comments: TIR only

requested source for columnar water vapor	user		user-supplied		

Comments: The end user can request a specific source, if available.

requested source for DEM	user		user-supplied		

Comments: The end user can request a specific source, if available.

requested source for MODTRAN aerosol	user		user-supplied		

Comments: The end user can request a specific source, if available.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
requested source for pressure profile	user		user-supplied		

Comments: The end user can request a specific source, if available.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
requested source for temperature profile	user		user-supplied		

Comments: The end user can request a specific source, if available.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
scene classification (fine)	3804		ASTER int prod	AST10	Scene classification

Comments: If requested by a user, a cloud mask generated by the scene classification algorithm will be appended to the product. To generate this mask the algorithm will use the high-quality atmospheric correction information available from the surface radiance products.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
temperature profile	3726	1	EOS--AM1	MOD30	Temperature profile

Comments: Uses NMC forecast data as an initial condition for an iterative solution.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
temperature profile	NMC	2	non-EOS		

Comments: This is an operational weather forecast system and could provide profiles coincident with receipt of raw ASTER data. The dataset needed is the "Global Analysis and Forecast System, 1.0 x 1.0 degree resolution", as described by Frank Huang. The files are generically named "gdas1.TxxZ.PGrbF00", where xx = 00, 06, 12, or 18. The files are found at the NMC ftp site ftp://nic.fb4.noaa.gov/pub/fnl/.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
temperature profile	DAO GEOS	3	IDS		

Comments: This is the Goddard Data Assimilation Office system.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
temperature profile	climatology	4	ASTER PGS int		

Comments: This would come from an internal climate-based model accounting for latitude, longitude, and season based on profiles associated with MODTRAN.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
water vapor profile	3727	1	EOS--AM1	MOD30	Water vapor profile

Comments: This MODIS product uses NMC forecast data (which itself is an alternative input) as an initial condition for an iterative solution.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
water vapor profile	NMC	2	non-EOS		

Comments: This is an operational weather forecast system and could provide profiles coincident with receipt of raw ASTER data. It would be used only if no MODIS data were available. The dataset needed is the "Global Analysis and Forecast System, 1.0 x 1.0 degree resolution", as described by Frank Huang. The files are generically named "gdas1.TxxZ.PGrbF00", where xx = 00, 06, 12, or 18. The files are found at the NMC ftp site ftp://nic.fb4.noaa.gov/pub/fnl/.

Input Dependencies for: Surface radiance--TIR 3817

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
water vapor profile	DAO GEOS	3	IDS		

Comments: This is the Goddard Data Assimilation Office system. If initial version of the product is available within 12 h this may move to the number 1 data source.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
water vapor profile	3725	4	EOS--AM1	MOD38	Water vapor, atmospheric (thermal IR)

Comments: This product provides an overall estimate of the amount of water in the column; uncertainty is >20% or 5 mm. It can be used as a basis for developing a profile.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
water vapor profile	climatology	5	ASTER PGS int		

Comments: This would come from an internal, climate-based model accounting for latitude, longitude, and season based on profiles associated with MODTRAN.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
brightness temperature lookup table	algorithm developer		ASTER PGS int		
Comments:					
brightness temperature lookup table	algorithm developer		ASTER PGS int		
Comments:					
desired output	user		user-supplied		
Comments: The user may specify temperature only, emissivity only, or both.					
formula parameters	algorithm developer		ASTER PGS int		
Comments: Run-time parameters for the algorithm (not end-user specifiable)					
iteration control parameters	algorithm developer				
Comments: There are several parameters that control the iteration mechanism, such as the maximum number of iterations allowed.					
scene classification (fine)	3804		ASTER int prod	AST10	Scene classification
Comments: Scene classification is generated as an interim product so that cloudy pixels can be identified and stored as an appended cloud mask if the user requests. Unlike the scene class used for d-stretch, this one uses true atmospherically corrected data from the VNIR/SWIR algorithm.					
surface radiance--TIR	3817		ASTER std	AST09	Surface radiance--TIR
Comments:					

Input Dependencies for: Surface kinetic temperature 3803

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
same as 2124--surface emissivity	see 2124				

Input Dependencies for: Polar surface and cloud classification 3818

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
coastline data	algorithm developers		ASTER PGS int		

Comments: Will use World Data Bank II coastline system-- world is divided into five regions, each with 11 classes; 500 m resolution, with lakes and rivers. 250 m resolution may become available (MODIS wants this and is pushing EROS to create it). This would be used if it is available.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
DEM	any		EOS		

Comments: Need at least 100 m resolution

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
ecosystem map	algorithm developers		ASTER PGS int		

Comments: (Same as EDC Land Cover). Will use EPA Global Ecosystems (WE1.4D), which is a 1080 x 2160 byte array containing 59 different ecosystem classes; 10 minute resolution. Not that EDC (Tom Loveland) is creating a 1KM global ecosystem map for pathfinder. This will be finished before launch, and will be used.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor

Comments: Needed to calculate reflectance if the reflectance product is inadequate, or for missing pixels in the reflectance product.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
sea ice coverage	3153		EOS--AM1	MOD29	Sea Ice Coverage

Comments: Development time frame is after launch. Primarily for comparison with the derived parameter to help determine success of classification processing. Not required but improves QA.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
snow cover	3020	1	EOS--AM1	MOD10	Snow cover

Comments: Development time frame is after launch. Primarily for comparison with the derived parameter (e.g. QA); not a required input.

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
snow cover	NESDIS snow/ice	2	non-EOS		

Comments: Available at launch

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
surface temperature	DAO		non-EOS		

Comments: Minimum temporal resolution required is about 6 hours. If this cannot be met, use 24 hrs (from previous day). This information is used to check the product. If there is an inconsistency, then additional processing occurs.

Input Dependencies for: Digital elevation model (DEM) 2828

Input Item	Sources	Pri	Source Type	Prod ID	Parameter Name of Source
Ground control points	TBS				
Comments:					
registered radiance at sensor	2452		ASTER std	AST03	Registered radiance at sensor
Comments:					

5. Data Product Contents

In addition to the Generic Header, each product contains a variety of product-specific information in both the header and the body. This section describes the various product-specific items for each product, for which the information described below is provided.

Content Item/Keyword. Each content item in the Product-Specific header is identified by a keyword as described earlier. Product Body items do not have keywords but are identified here by descriptive names. Keywords beginning with "RTI" represent information supplied as run time inputs, such as that specified by a user or taken from a parameter file. All runtime inputs will have default values so that the user is not required to enter values for them.

b/h. Indicates whether the content item is part of the body (b) or the header (h).

HDF Type. Specifies the type of HDF object that the content item will be stored as. Eventually this will replace the b/h designation, which is too narrow. The data in this column are preliminary.

Units. The units associated with the content item.

Datatype. The datatype of the content item as it appears in the product. Note that all items in the Product-Specific Header are of the character datatype to simplify use of the product.

Size. The size in bytes of the content item for items in the product body. Items in the Product-Specific Header may be of any length.

Comments. Describes the content item and provides additional information.

Appendix D describes the structure of the Second QA Data Plane for each product. This data plane contains product-specific pixel-level QA information.

Contents for: Reconstructed, unprocessed instrument data 3801

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments

See Level 1 Product Specification

Contents for: Registered radiance at sensor 2452

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments

See Level 1 Product Specification

Contents for: Scene classification 3804

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
Part of QA Data Plane 1--See App D of SDPS						

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_INPUT_BAND_1	h	attributes (P=V)	none	char		First selected input band
RTI_INPUT_BAND_2	h	attributes (P=V)	none	char		Second selected input band
RTI_INPUT_BAND_3	h	attributes (P=V)	none	char		Third selected input band
RTI_FIRST_STAT_LINE	h	attributes (P=V)	none	char		Number of 1st line to use for stats
RTI_LAST_STAT_LINE	h	attributes (P=V)	none	char		Number of last line to use for stats
RTI_FIRST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of 1st pixel to use for stats
RTI_LAST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of last pixel to use for stats
RTI_CORR_COVAR_PICK	h	attributes (P=V)	none	char		"Correlation" or "Covariance" matrix
RTI_OUTPUT_STDDEV	h	attributes (P=V)	none	char		User's choice of desired standard deviation of outputs
RTI_OUTPUT_MEAN	h	attributes (P=V)	none	char		User's choice of desired means of output bands
RTI_STAT_PIXEL_FREQUENCY	h	attributes (P=V)	none	char		'Skip' factor in sampling for statistics
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
NUM_STAT_LINES	h	attributes (P=V)	none	char		Number of lines of input data used to generate statistics.
NUM_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels used to generate statistics.
BAD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
CLOUD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
LINES_PROCESSED	h	attributes (P=V)	none	char		Number of lines of input data stretched
GOOD_PIXELS	h	attributes (P=V)	none	char		Number of good pixels processed in stretching image
BAD_PIXELS	h	attributes (P=V)	none	char		Number of bad pixels processed in stretching image
CLOUD_PIXELS	h	attributes (P=V)	none	char		Number of cloud pixels processed in stretching image
BAND_MEANS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated means of 3 bands used

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
BAND_STDDEVS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated standard deviations of 3 bands used
COVARIANCE_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix
CORRELATION_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix, Optional
EIGEN_VALUES	h	attributes (P=V)	none	char		List: the 3 eigenvalues
EIGEN_VECTORS	h	attributes (P=V)	none	char		List: the 9 elements of the 3 eigenvectors
TRANSFORM_MATRIX	h	attributes (P=V)	none	char		List: the 12 elements of the matrix (a 3 x 4 matrix)
OFFSET_VECTOR	h	attributes (P=V)	none	char		Vector added to each output vector
MESSAGES	h		none	char		Messages generated during processing.
Data Plane 1	b	SDS (array)	none	integer	1	Stretched image numbers for first input band
Data Plane 2	b	SDS (array)	none	integer	1	Stretched image numbers for second input band
Data Plane 3	b	SDS (array)	none	integer	1	Stretched image numbers for third input band
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_INPUT_BAND_1	h	attributes (P=V)	none	char		First selected input band
RTI_INPUT_BAND_2	h	attributes (P=V)	none	char		Second selected input band
RTI_INPUT_BAND_3	h	attributes (P=V)	none	char		Third selected input band
RTI_FIRST_STAT_LINE	h	attributes (P=V)	none	char		Number of 1st line to use for stats
RTI_LAST_STAT_LINE	h	attributes (P=V)	none	char		Number of last line to use for stats
RTI_FIRST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of 1st pixel to use for stats
RTI_LAST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of last pixel to use for stats
RTI_CORR_COVAR_PICK	h	attributes (P=V)	none	char		"Correlation" or "Covariance" matrix
RTI_OUTPUT_STDDEV	h	attributes (P=V)	none	char		User's choice of desired standard deviation of outputs
RTI_OUTPUT_MEAN	h	attributes (P=V)	none	char		User's choice of desired means of output bands
RTI_STAT_PIXEL_FREQUENCY	h	attributes (P=V)	none	char		'Skip' factor in sampling for statistics
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
NUM_STAT_LINES	h	attributes (P=V)	none	char		Number of lines of input data used to generate statistics.
NUM_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels used to generate statistics.
BAD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
CLOUD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
LINES_PROCESSED	h	attributes (P=V)	none	char		Number of lines of input data stretched
GOOD_PIXELS	h	attributes (P=V)	none	char		Number of good pixels processed in stretching image
BAD_PIXELS	h	attributes (P=V)	none	char		Number of bad pixels processed in stretching image
CLOUD_PIXELS	h	attributes (P=V)	none	char		Number of cloud pixels processed in stretching image
BAND_MEANS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated means of 3 bands used

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
BAND_STDDEVS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated standard deviations of 3 bands used
COVARIANCE_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix
CORRELATION_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix, Optional
EIGEN_VALUES	h	attributes (P=V)	none	char		List: the 3 eigenvalues
EIGEN_VECTORS	h	attributes (P=V)	none	char		List: the 9 elements of the 3 eigenvectors
TRANSFORM_MATRIX	h	attributes (P=V)	none	char		List: the 12 elements of the matrix (a 3 x 4 matrix)
OFFSET_VECTOR	h	attributes (P=V)	none	char		Vector added to each output vector
MESSAGES	h		none	char		Messages generated during processing.
Data Plane 1	b	SDS (array)	none	integer	1	Stretched image numbers for first input band
Data Plane 2	b	SDS (array)	none	integer	1	Stretched image numbers for second input band
Data Plane 3	b	SDS (array)	none	integer	1	Stretched image numbers for third input band
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_INPUT_BAND_1	h	attributes (P=V)	none	char		First selected input band
RTI_INPUT_BAND_2	h	attributes (P=V)	none	char		Second selected input band
RTI_INPUT_BAND_3	h	attributes (P=V)	none	char		Third selected input band
RTI_FIRST_STAT_LINE	h	attributes (P=V)	none	char		Number of 1st line to use for stats
RTI_LAST_STAT_LINE	h	attributes (P=V)	none	char		Number of last line to use for stats
RTI_FIRST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of 1st pixel to use for stats
RTI_LAST_STAT_PIXEL	h	attributes (P=V)	none	char		Number of last pixel to use for stats
RTI_CORR_COVAR_PICK	h	attributes (P=V)	none	char		"Correlation" or "Covariance" matrix
RTI_OUTPUT_STDDEV	h	attributes (P=V)	none	char		User's choice of desired standard deviation of outputs
RTI_OUTPUT_MEAN	h	attributes (P=V)	none	char		User's choice of desired means of output bands
RTI_STAT_PIXEL_FREQUENCY	h	attributes (P=V)	none	char		'Skip' factor in sampling for statistics
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
NUM_STAT_LINES	h	attributes (P=V)	none	char		Number of lines of input data used to generate statistics.
NUM_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels used to generate statistics.
BAD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
CLOUD_STAT_PIXELS	h	attributes (P=V)	none	char		Number of pixels rejected in gathering stats
LINES_PROCESSED	h	attributes (P=V)	none	char		Number of lines of input data stretched
GOOD_PIXELS	h	attributes (P=V)	none	char		Number of good pixels processed in stretching image
BAD_PIXELS	h	attributes (P=V)	none	char		Number of bad pixels processed in stretching image
CLOUD_PIXELS	h	attributes (P=V)	none	char		Number of cloud pixels processed in stretching image
BAND_MEANS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated means of 3 bands used

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
BAND_STDDEVS	h	attributes (P=V)	W/m^2/sr/um	char		List: estimated standard deviations of 3 bands used
COVARIANCE_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix
CORRELATION_MATRIX	h	attributes (P=V)	none	char		List: the 9 elements of the matrix, Optional
EIGEN_VALUES	h	attributes (P=V)	none	char		List: the 3 eigenvalues
EIGEN_VECTORS	h	attributes (P=V)	none	char		List: the 9 elements of the 3 eigenvectors
TRANSFORM_MATRIX	h	attributes (P=V)	none	char		List: the 12 elements of the matrix (a 3 x 4 matrix)
MESSAGES	h		none	char		Messages generated during processing.
OFFSET_VECTOR	h	attributes (P=V)	none	char		Vector added to each output vector
Data Plane 1	b	SDS (array)	none	integer	1	Stretched image numbers for first input band
Data Plane 2	b	SDS (array)	none	integer	1	Stretched image numbers for second input band
Data Plane 3	b	SDS (array)	none	integer	1	Stretched image numbers for third input band
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
RTI_LUT_VERSION	h	attributes (P=V)	none	char		The version number of the LUT
CLOUD_PIXELS	h	attributes (P=V)	none	char		number of cloud pixels
PIXELS_SET_MAX	h	attributes (P=V)	none	char		number of pixels which produced a super-max value on lookup, max reported
PIXELS_SET_MIN	h	attributes (P=V)	none	char		number of pixels which produced a sub-min value on lookup, min reported
BT_HISTOGRAM1	h	attributes (P=V)	none	char		Histogram of Data Plane 1 with 1 hundredth degree resolution
BT_HISTOGRAM2	h	attributes (P=V)	none	char		Histogram of Data Plane 2 with 1 hundredth degree resolution
BT_HISTOGRAM3	h	attributes (P=V)	none	char		Histogram of Data Plane 3 with 1 hundredth degree resolution
BT_HISTOGRAM4	h	attributes (P=V)	none	char		Histogram of Data Plane 4 with 1 hundredth degree resolution
BT_HISTOGRAM5	h	attributes (P=V)	none	char		Histogram of Data Plane 5 with 1 hundredth degree resolution
Brightness Temperature Band 10	b	SDS (array)	degrees C	char	2	Brightness Temperature for band 10, hundredths of degrees Celsius (i.e., scaled by 100x)
Brightness Temperature Band 11	b	SDS (array)	degrees C	char	2	Brightness Temperature for band 11, hundredths of degrees Celsius (i.e., scaled by 100x)
Brightness Temperature Band 12	b	SDS (array)	degrees C	char	2	Brightness Temperature for band 12, hundredths of degrees Celsius (i.e., scaled by 100x)
Brightness Temperature Band 13	b	SDS (array)	degrees C	char	2	Brightness Temperature for band 13, hundredths of degrees Celsius (i.e., scaled by 100x)
Brightness Temperature Band 14	b	SDS (array)	degrees C	char	2	Brightness Temperature for band 14, hundredths of degrees Celsius (i.e., scaled by 100x)
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_AEROSOL_OD_SRC	h	attributes (P=V)	none	char		run time input - requested source: aerosol optical depth
RTI_DEM_SRC	h	attributes (P=V)	none	char		run time input - requested source: digital elevation model
RTI_JUNGE_SRC	h	attributes (P=V)	none	char		run time input - requested source: junge parameter
RTI_M_H2O_SRC	h	attributes (P=V)	none	char		run time input - requested source: columnar water vapor profile
RTI_M_O3_SRC	h	attributes (P=V)	none	char		run time input - requested source: columnar ozone profile
RTI_M_PRESS_SRC	h	attributes (P=V)	none	char		run time input - requested source: pressure profile
RTI_M_TEMP_SRC	h	attributes (P=V)	none	char		run time input - requested source: temperature profile
RTI_MOLECULAR_OD_SRC	h	attributes (P=V)	none	char		run time input - requested source: molecular optical depth
RTI_SSA_SRC	h	attributes (P=V)	none	char		run time input - requested source: aerosol single scatter albedo
RTI_LUT_VERS	h	attributes (P=V)	none	char		run time input - which version of look up table to use
RTI_MODTRAN_VERS	h	attributes (P=V)	none	char		run time input - which version of modtran to use
AEROSOL_OD_SRC	h	attributes (P=V)	none	char		source used for this product: aerosol optical depth
AEROSOL_OD_MEAN	h	attributes (P=V)	none	char		mean for entire scene: aerosol optical depth
AEROSOL_OD_RES	h	attributes (P=V)	m	char		resolution of source: aerosol optical depth
AEROSOL_OD_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene):aerosol optical depth
AEROSOL_OD_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: aerosol optical depth
AEROSOL_SSA_SRC	h	attributes (P=V)	none	char		source used for this product: aerosol single scatter albedo
AEROSOL_SSA_MEAN	h	attributes (P=V)	none	char		mean for entire scene: aerosol single scatter albedo
AEROSOL_SSA_RES	h	attributes (P=V)	m	char		resolution of source: aerosol single scatter albedo
AEROSOL_SSA_STDEV	h	attributes (P=V)	none	char		standard deviation: aerosol single scatter albedo
AEROSOL_SSA_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: aerosol single scatter albedo

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
JUNGE_SRC	h	attributes (P=V)	none	char		source used for this product: junge parameter (size distribution)
JUNGE_MEAN	h	attributes (P=V)	none	char		mean for entire scene: junge parameter
JUNGE_RES	h	attributes (P=V)	m	char		resolution of source: junge parameter
JUNGE_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene): junge parameter
JUNGE_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: junge parameter
MOLECULAR_OD_SRC	h	attributes (P=V)	none	char		source used for this product: molecular optical depth
MOLECULAR_OD_MEAN	h	attributes (P=V)	none	char		mean for entire scene: molecular optical depth
MOLECULAR_OD_RES	h	attributes (P=V)	m	char		resolution of source: molecular optical depth
MOLECULAR_OD_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene): molecular optical depth
MOLECULAR_OD_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: molecular optical depth
MODTRAN_LEVELS	h	attributes (P=V)	m	char		list of altitude levels in profile
MODTRAN_H2O_SRC	h	attributes (P=V)	none	char		source used for this product: columnar water vapor profile
MODTRAN_H2O_RES	h	attributes (P=V)	m	char		x-y resolution of source: columnar water vapor profile
MODTRAN_H2O_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: columnar water vapor profile
MODTRAN_O3_SRC	h	attributes (P=V)	none	char		source used for this product: ozone profile
MODTRAN_O3_RES	h	attributes (P=V)	m	char		x-y resolution of source: ozone profile
MODTRAN_O3_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: ozone profile
MODTRAN_PRESS_SRC	h	attributes (P=V)	none	char		source used for this product: pressure profile
MODTRAN_PRESS_RES	h	attributes (P=V)	m	char		x-y resolution of source: pressure profile
MODTRAN_PRESS_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: pressure profile
MODTRAN_TEMP_SRC	h	attributes (P=V)	none	char		source used for this product: temperature profile

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
MODTRAN_TEMP_RES	h	attributes (P=V)	m	char		x-y resolution of source: temperature profile
MODTRAN_TEMP_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: temperature profile
DEM_SRC	h	attributes (P=V)	none	char		source of dem
DEM_ELEVATION_UNCERT	h	attributes (P=V)	m	char		uncertainty of dem (pixel avg.)
DEM_MAX_ELEVATION	h	attributes (P=V)	m	char		maximum elevation in scene
DEM_MAX_SLOPE	h	attributes (P=V)	degrees	char		maximum slope in scene
DEM_MIN_ELEVATION	h	attributes (P=V)	m	char		minimum elevation (for entire scene)
DEM_MIN_SLOPE	h	attributes (P=V)	degrees	char		minimum slope (for entire scene)
DEM_RES	h	attributes (P=V)	m	char		resolution of dem
DEM_SLOPE_UNCERT	h	attributes (P=V)	degrees	char		uncertainty of dem (pixel avg.)
Filter_Profile_1	b	Vdata (table)	none	TBD		filter profile for band 1
Filter_Profile_2	b	Vdata (table)	none	TBD		filter profile for band 2
Filter_Profile_3	b	Vdata (table)	none	TBD		filter profile for band 3
Filter_Profile_3B	b	Vdata (table)	none	TBD		filter profile for band 3B
Filter_Profile_4	b	Vdata (table)	none	TBD		filter profile for band 4
Filter_Profile_5	b	Vdata (table)	none	TBD		filter profile for band 5
Filter_Profile_6	b	Vdata (table)	none	TBD		filter profile for band 6
Filter_Profile_7	b	Vdata (table)	none	TBD		filter profile for band 7
Filter_Profile_8	b	Vdata (table)	none	TBD		filter profile for band 8
Filter_Profile_9	b	Vdata (table)	none	TBD		filter profile for band 9
MASK_USED	h	attributes (P=V)	none	char		whether or not mask was used

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
Surface Reflectance Band 1	b	grid	none	integer	2	surface reflectance for band 1
Surface Reflectance Band 2	b	grid	none	integer	2	surface reflectance for band 2
Surface Reflectance Band 3n	b	grid	none	integer	2	surface reflectance for band 3n
Surface Reflectance Band 3b	b	grid	none	integer	2	surface reflectance for band 3b
Surface Reflectance Band 4	b	grid	none	integer	2	surface reflectance for band 4
Surface Reflectance Band 5	b	grid	none	integer	2	surface reflectance for band 5
Surface Reflectance Band 6	b	grid	none	integer	2	surface reflectance for band 6
Surface Reflectance Band 7	b	grid	none	integer	2	surface reflectance for band 7
Surface Reflectance Band 8	b	grid	none	integer	2	surface reflectance for band 8
Surface Reflectance Band 9	b	grid	none	integer	2	surface reflectance for band 9
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	8	This data plane is 8 bits per pixel for VNIR, and 16 for SWIR. It contains uncertainty information for each channel. See App. D of SDPS For details.

Contents for: Surface radiance--VNIR, SWIR 2378

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_AEROSOL_OD_SRC	h	attributes (P=V)	none	char		run time input - requested source: aerosol optical depth
RTI_DEM_SRC	h	attributes (P=V)	none	char		run time input - requested source: digital elevation model
RTI_JUNGE_SRC	h	attributes (P=V)	none	char		run time input - requested source: junge parameter
RTI_M_H2O_SRC	h	attributes (P=V)	none	char		run time input - requested source: columnar water vapor profile
RTI_M_O3_SRC	h	attributes (P=V)	none	char		run time input - requested source: columnar ozone profile
RTI_M_PRESS_SRC	h	attributes (P=V)	none	char		run time input - requested source: pressure profile
RTI_M_TEMP_SRC	h	attributes (P=V)	none	char		run time input - requested source: temperature profile
RTI_MOLECULAR_OD_SRC	h	attributes (P=V)	none	char		run time input - requested source: molecular optical depth
RTI_SSA_SRC	h	attributes (P=V)	none	char		run time input - requested source: aerosol single scatter albedo
RTI_LUT_VERS	h	attributes (P=V)	none	char		run time input - which version of look up table to use
RTI_MODTRAN_VERS	h	attributes (P=V)	none	char		run time input - which version of modtran to use
AEROSOL_OD_SRC	h	attributes (P=V)	none	char		source used for this product: aerosol optical depth
AEROSOL_OD_MEAN	h	attributes (P=V)	none	char		mean for entire scene: aerosol optical depth
AEROSOL_OD_RES	h	attributes (P=V)	m	char		resolution of source: aerosol optical depth
AEROSOL_OD_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene):aerosol optical depth
AEROSOL_OD_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: aerosol optical depth
AEROSOL_SSA_SRC	h	attributes (P=V)	none	char		source used for this product: aerosol single scatter albedo
AEROSOL_SSA_MEAN	h	attributes (P=V)	none	char		mean for entire scene: aerosol single scatter albedo
AEROSOL_SSA_RES	h	attributes (P=V)	m	char		resolution of source: aerosol single scatter albedo
AEROSOL_SSA_STDEV	h	attributes (P=V)	none	char		standard deviation: aerosol single scatter albedo
AEROSOL_SSA_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: aerosol single scatter albedo

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
JUNGE_SRC	h	attributes (P=V)	none	char		source used for this product: junge parameter (size distribution)
JUNGE_MEAN	h	attributes (P=V)	none	char		mean for entire scene: junge parameter
JUNGE_RES	h	attributes (P=V)	m	char		resolution of source: junge parameter
JUNGE_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene): junge parameter
JUNGE_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: junge parameter
MOLECULAR_OD_SRC	h	attributes (P=V)	none	char		source used for this product: molecular optical depth
MOLECULAR_OD_MEAN	h	attributes (P=V)	none	char		mean for entire scene: molecular optical depth
MOLECULAR_OD_RES	h	attributes (P=V)	m	char		resolution of source: molecular optical depth
MOLECULAR_OD_STDEV	h	attributes (P=V)	none	char		standard deviation (of samples in scene): molecular optical depth
MOLECULAR_OD_UNCERT	h	attributes (P=V)	none	char		uncertainty estimate for each sample: molecular optical depth
MODTRAN_LEVELS	h	attributes (P=V)	m	char		list of altitude levels in profiles
MODTRAN_H2O_SRC	h	attributes (P=V)	none	char		source used for this product: columnar water vapor profile
MODTRAN_H2O_RES	h	attributes (P=V)	m	char		x-y resolution of source: columnar water vapor profile
MODTRAN_H2O_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: columnar water vapor profile
MODTRAN_O3_SRC	h	attributes (P=V)	none	char		source used for this product: ozone profile
MODTRAN_O3_RES	h	attributes (P=V)	m	char		x-y resolution of source: ozone profile
MODTRAN_O3_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: ozone profile
MODTRAN_PRESS_SRC	h	attributes (P=V)	none	char		source used for this product: pressure profile
MODTRAN_PRESS_RES	h	attributes (P=V)	m	char		x-y resolution of source: pressure profile
MODTRAN_PRESS_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: pressure profile
MODTRAN_TEMP_SRC	h	attributes (P=V)	none	char		source used for this product: temperature profile

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
MODTRAN_TEMP_RES	h	attributes (P=V)	m	char		x-y resolution of source: temperature profile
MODTRAN_TEMP_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: temperature profile
DEM_SRC	h	attributes (P=V)	none	char		source of dem
DEM_ELEVATION_UNCERT	h	attributes (P=V)	m	char		uncertainty of dem (pixel avg.)
DEM_MAX_ELEVATION	h	attributes (P=V)	m	char		maximum elevation in scene
DEM_MAX_SLOPE	h	attributes (P=V)	degrees	char		maximum slope in scene
DEM_MIN_ELEVATION	h	attributes (P=V)	m	char		minimum elevation (for entire scene)
DEM_MIN_SLOPE	h	attributes (P=V)	degrees	char		minimum slope (for entire scene)
DEM_RES	h	attributes (P=V)	m	char		resolution of dem
DEM_SLOPE_UNCERT	h	attributes (P=V)	degrees	char		uncertainty of dem (pixel avg.)
Filter_Profile_1	b	Vdata (table)	none	TBD		filter profile for band 1
Filter_Profile_2	b	Vdata (table)	none	TBD		filter profile for band 2
Filter_Profile_3	b	Vdata (table)	none	TBD		filter profile for band 3
Filter_Profile_3B	b	Vdata (table)	none	TBD		filter profile for band 3B
Filter_Profile_4	b	Vdata (table)	none	TBD		filter profile for band 4
Filter_Profile_5	b	Vdata (table)	none	TBD		filter profile for band 5
Filter_Profile_6	b	Vdata (table)	none	TBD		filter profile for band 6
Filter_Profile_7	b	Vdata (table)	none	TBD		filter profile for band 7
Filter_Profile_8	b	Vdata (table)	none	TBD		filter profile for band 8
Filter_Profile_9	b	Vdata (table)	none	TBD		filter profile for band 9
MASK_USED	h	attributes (P=V)	none	char		whether or not mask was used

Contents for: Surface radiance--VNIR, SWIR 2378

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
Surface Radiance Band 1	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 1
Surface Radiance Band 2	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 2
Surface Radiance Band 3n	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 3n
Surface Radiance Band 3b	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 3b
Surface Radiance Band 4	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 4
Surface Radiance Band 5	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 5
Surface Radiance Band 6	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 6
Surface Radiance Band 7	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 7
Surface Radiance Band 8	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 8
Surface Radiance Band 9	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 9
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	8	This data plane is 8 bits per pixel for VNIR, and 16 for SWIR. It contains uncertainty information for each channel. See App. D of SDPS For details.

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
RTI_DEM_SRC	h	attributes (P=V)	none	char		run time input - requested source: digital elevation model
RTI_M_H2O_SRC	h	attributes (P=V)	none	char		run time input - requested source: columnar water vapor profile
RTI_M_PRES_SRC	h	attributes (P=V)	none	char		run time input - requested source: pressure profile
RTI_AER_SRC	h	attributes (P=V)	none	char		run time input - requested source: modtran aerosol parameters
RTI_M_TEMP_SRC	h	attributes (P=V)	none	char		run time input - requested source: temperature profile
RTI_MODTRAN_VERS	h	attributes (P=V)	none	char		run time input - which version of modtran to use
MODTRAN_LEVELS	h	attributes (P=V)	m	char		list of altitude levels in profile
MODTRAN_H2O_SRC	h	attributes (P=V)	none	char		source used for this product: columnar water vapor profile
MODTRAN_H2O_RES	h	attributes (P=V)	m	char		x-y resolution of source: columnar water vapor profile
MODTRAN_H2O_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: columnar water vapor profile
MODTRAN_O3_SRC	h	attributes (P=V)	none	char		source used for this product: ozone profile
MODTRAN_O3_RES	h	attributes (P=V)	m	char		x-y resolution of source: ozone profile
MODTRAN_O3_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: ozone profile
MODTRAN_PRES_SRC	h	attributes (P=V)	none	char		source used for this product: pressure profile
MODTRAN_PRES_RES	h	attributes (P=V)	m	char		x-y resolution of source: pressure profile
MODTRAN_PRES_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: pressure profile
MODTRAN_TEMP_SRC	h	attributes (P=V)	none	char		source used for this product: temperature profile
MODTRAN_TEMP_RES	h	attributes (P=V)	m	char		x-y resolution of source: temperature profile
MODTRAN_TEMP_UNCERT	h	attributes (P=V)		char		uncertainty estimate for each sample: temperature profile
DEM_SRC	h	attributes (P=V)	none	char		source of dem
DEM_ELEVATION_UNCERT	h	attributes (P=V)	m	char		uncertainty of dem (pixel avg.)

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
DEM_MAX_ELEVATION	h	attributes (P=V)	m	char		maximum elevation in scene
DEM_MAX_SLOPE	h	attributes (P=V)	degrees	char		maximum slope in scene
DEM_MIN_ELEVATION	h	attributes (P=V)	m	char		minimum elevation (for entire scene)
DEM_MIN_SLOPE	h	attributes (P=V)	degrees	char		minimum slope (for entire scene)
DEM_RES	h	attributes (P=V)	m	char		resolution of dem
DEM_SLOPE_UNCERT	h	attributes (P=V)	degrees	char		uncertainty of dem (pixel avg.)
Filter_Profile_10	b	Vdata (table)	none	TBD		filter profile for band 10
Filter_Profile_11	b	Vdata (table)	none	TBD		filter profile for band 11
Filter_Profile_12	b	Vdata (table)	none	TBD		filter profile for band 12
Filter_Profile_13	b	Vdata (table)	none	TBD		filter profile for band 13
Filter_Profile_14	b	Vdata (table)	none	TBD		filter profile for band 14
MASK_USED	h	attributes (P=V)	none	char		whether or not mask was used
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
Surface Radiance Band 10	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 10
Surface Radiance Band 11	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 11
Surface Radiance Band 12	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 12
Surface Radiance Band 13	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 13
Surface Radiance Band 14	b	grid	W/m^2/sr/um	integer	2	surface radiance for band 14
Sky Irradiance Band 10	b	grid	W/m^2/um	integer	2	sky irradiance for band 10
Sky Irradiance Band 11	b	grid	W/m^2/um	integer	2	sky irradiance for band 11

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
Sky Irradiance Band 12	b	grid	W/m^2/um	integer	2	sky irradiance for band 12
Sky Irradiance Band 13	b	grid	W/m^2/um	integer	2	sky irradiance for band 13
Sky Irradiance Band 14	b	grid	W/m^2/um	integer	2	sky irradiance for band 14
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	16	Contains uncertainty information for each channel, and also whether the pixel is good/not good for each channel. See App. D of SDPS for details.

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
MIN_FORMULA	h		none	char		Formula for minimum emissivity as a function of the standard deviation of emissivity ratios.
C1_RADIATION_CONSTANT	h		W*m^2	char		Value: 3.74151 * 10^16
C2_RADIATION_CONSTANT	h		m*degK	char		Value: .0143879
NUM_PIXELS_SET_MIN	h		none	char		Nums of pixels set to the minimum emissivity value, 1 for each plane1-5
NUM_PIXELS_SET_MAX	h		none	char		Nums of pixels set to the maximum emissivity value, 1 for each plane 1-5
MAX_ITERATIONS	h		none	char		max iterations of main loop (comp. emiss, correct for sky) done
FIRST_DIFF_TOLERANCE	h		none	char		first difference in sequence of radiances, used to decide to stop main loop
2ND_DIFF_TOLERANCE	h		none	char		threshold in 2nd difference in sequence of radiances, used to
FIRST_DELTA_SAMPLES	h		none	char		number of points in sequence from which to compute first deltas
VARIANCE_THRESHOLD	h		none	char		triggers computation of max. emissivity to use in computing normalized emissivities
FIRST_DERIV_THRESHOLD	h		none	char		used to determine whether to use computed max. emissivity value
CALCED_VARIANCE_THRESHOLD	h		none	char		on minimum variance calculated by function generated to express max. emissivity vs. variance curve
INITIAL_PARABALOID	h		none	char		List: set of max. emissivity values to evaluate in generating max. emissivity
IRRAD_CORRECTION_E_MAX	h		none	char		when correcting for sky irradiance, this value always used to calculate normalized emissivities
PLANES_1_5_DESCRIPTION	h		none	char		Description of emissivity planes 1-5
LAST_PLANE_DESCRIPTION	h		none	char		Description of high temperature band plane
BAND_10_E_HIST	h		none	char		Histogram of emissivities in band 10, binned at .001

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
BAND_11_E_HIST	h		none	char		Histogram of emissivities in band 11, binned at .001
BAND_12_E_HIST	h		none	char		Histogram of emissivities in band 12, binned at .001
BAND_13_E_HIST	h		none	char		Histogram of emissivities in band 13, binned at .001
BAND_14_E_HIST	h		none	char		Histogram of emissivities in band 14, binned at .001
Emissivity for Band 10	b		none	integer	2	Emissivities for band 10
Emissivity for Band 11	b		none	integer	2	Emissivities for band 11
Emissivity for Band 12	b		none	integer	2	Emissivities for band 12
Emissivity for Band 13	b		none	integer	2	Emissivities for band 13
Emissivity for Band 14	b		none	integer	2	Emissivities for band 14
Normalizing Band	b		none	integer	2	Band whose temperature was used to generated normalized emissivities.
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	24	Contains the error status for each band, as well E_MAX, number of iterations, and the ratio of Sky Irradiance to Land-Leaving Radiance. See App D of the SDPS for details.

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
MIN_FORMULA	h		none	char		Formula for minimum emissivity as a function of the standard deviation of emissivity ratios.
C1_RADIATION_CONSTANT	h		W*m^2	char		Value: 3.74151 * 10^16
C2_RADIATION_CONSTANT	h		m*degK	char		Value: .0143879
NUM_PIXELS_SET_MIN	h		none	char		Nums of pixels set to the minimum emissivity value, 1 for each plane 1-5
NUM_PIXELS_SET_MAX	h		none	char		Nums of pixels set to the maximum emissivity value, 1 for each plane 1-5
MAX_ITERATIONS	h		none	char		max iterations of main loop (comp. emiss, correct for sky) done
FIRST_DIFF_TOLERANCE	h		none	char		first difference in sequence of radiances, used to decide to stop main loop
2ND_DIFF_TOLERANCE	h		none	char		threshold in 2nd difference in sequence of radiances, used to
FIRST_DELTA_SAMPLES	h		none	char		number of points in sequence from which to compute first deltas
VARIANCE_THRESHOLD	h		none	char		triggers computation of max. emissivity to use in computing normalized emissivities
FIRST_DERIV_THRESHOLD	h		none	char		used to determine whether to use computed max. emissivity value
CALCED_VARIANCE_THRESHOLD	h		none	char		on minimum variance calculated by function generated to express max. emissivity vs. variance curve
INITIAL_PARABALOID	h		none	char		List: set of max. emissivity values to evaluate in generating max. emissivity
IRRAD_CORRECTION_E_MAX	h		none	char		when correcting for sky irradiance, this value always used to calculate normalized emissivities
PLANE_1_DESCRIPTION	h		none	char		Description of temperature data plane (plane 1)
LAST_PLANE_DESCRIPTION	h		none	char		Description of high temperature band plane
BAND_10_E_HIST	h		none	char		Histogram of emissivities in band 10, binned at .001

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
BAND_11_E_HIST	h		none	char		Histogram of emissivities in band 11, binned at .001
BAND_12_E_HIST	h		none	char		Histogram of emissivities in band 12, binned at .001
BAND_13_E_HIST	h		none	char		Histogram of emissivities in band 13, binned at .001
BAND_14_E_HIST	h		none	char		Histogram of emissivities in band 14, binned at .001
TEMPERATURE_HIST	h		none	char		Histogram of Temperature, binned at tenths of deg K
Temperature	b		tenths of degrees K	integer	2	Temperatures
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	16	Contains the Accuracy and Precision for each pixel, as well as the band used for calculating the reported temperature. Also contains E_MAX, Number of Iterations, and ratio of Sky Irradiance to Land Leaving radiance. See App D of the SDPS for details.

Contents for: Polar surface and cloud classification

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
classification map with 8 classes	b	SDS (array)	none	bit		One byte per pixel
BAD_PIXEL_SWIR	h	attributes (P=V)	none	char		Number of pixels rejected because SWIR dropout/saturation
BAD_PIXEL_TIR	h	attributes (P=V)	none	char		Number of pixels rejected because TIR dropout/saturation
BAD_PIXEL_VNIR	h	attributes (P=V)	none	char		Number of pixels rejected because VNIR dropout/saturation
LAND_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as land
NUM_PIXEL_SELECT	h	attributes (P=V)	none	char		Num. pixels of the selected scene
NUM_PIXELS_INTER	h	attributes (P=V)	none	char		Num. pixels interpolated
SHADOW_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as shadow
SNOW/ICE_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as snow/ice
THICK_CLOUD_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as thick cloud
THIN_CLOUD_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as thin cloud
UNKNOWN_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as unknown
WATER_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as water
WET_ICE_PIXELS	h	attributes (P=V)	none	char		Num. pixels classified as wet_ice
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details. Note that the cloud bits will not be used for this product

Content Item/Keyword	b/h	HDF type	Units	Datatype	Size	Comments
CLOUD_MASK_SOURCE	h		none	char		Lists the sources used to generate the cloud mask stored in QA Data Plane 1.
DEM	b	SDS (array)		integer	2	The DEM.
QA Data Plane 1	b		none	bit	8	Contains good, bad, suspect, and cloud information for each pixel; see App. D of SDPS for details
QA Data Plane 2	b		none	bit	8	Contains the correlation coefficient between 3n and 3b. See App D. of the SDPS for details.

6. Details of the Second QA Data Plane

This section describes the structure of the Second QA Data Plane, which contains product-specific pixel-level QA information. Because QA requirements vary from product to product, not all products contain this plane. Also, its size varies among products, and sometimes among telescopes.

The planes were designed with several goals in mind:

- Providing as much useful QA information as possible
- Maintaining consistency between products as much as possible
- Making them as user-friendly as possible
- Keeping granule size as small as possible

Because some of these goals are contradictory, it was necessary to make some compromises.

6.1 Surface Reflectance

This product has an 8 bit Second QA Data Plane for the VNIR (nadir) telescope, and a 16 bit plane for the SWIR telescope. For VNIR the first 6 bits specify the uncertainty category for each of the nadir-looking VNIR channels. One of these uncertainty categories signifies that the pixel in that channel is considered "not good" (i.e., bad, or suspect). The remaining two bits are currently unassigned.

VNIR Surface Reflectance Uncertainty (per channel)	unassigned

1	2	3	4	5	6	7	8
Channel 1		Channel 2		Channel 3N			

For the SWIR telescope, the first 12 bits specify the uncertainty category for each channel; similar to VNIR, one of these uncertainty categories signifies that the pixel in that channel is "not good". The remaining four bits are currently unassigned.

SWIR Surface Reflectance Uncertainty (per channel)												unassigned			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Channel 4		Channel 5		Channel 6		Channel 7		Channel 8		Channel 9					

For both telescopes, the two bits per channel that categorize uncertainty have the following assignments ("not good" means that the pixel in that channel was either bad or suspect):

Binary Value	Uncertainty (U)
00	U < TBD%
01	TBD% < U < TBD%
10	TBD% < U < TBD%
11	Not good

6.2 Surface Radiance—VNIR/SWIR

Same as Surface Reflectance--VNIR/SWIR, except that the uncertainty is for surface radiance rather than surface reflectance.

6.3 Surface Radiance--TIR

This product has a 16 bit Second QA Data Plane. The first 10 bits specify the uncertainty category for each channel. The next five bits indicate for each channel whether it is considered good or not good ("not good" means the channel is either bad or suspect).

TIR Surface Radiance Uncertainty (per channel)										"Not Good" Flag (per channel)					Not Used
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Channel 10		Channel 11		Channel 12		Channel 13		Channel 14		C. 10	C. 11	C. 12	C. 13	C. 14	Not Used

The two bits per channel that categorize uncertainty have the following assignments:

Binary Value	Uncertainty (U)
00	U < 2%
01	2% < U < 5%
10	5% < U < 15%
11	U > 15%

If the "Not Good" flag is set, this indicates that the channel is not good for that pixel.

6.4 Surface Emissivity

This product has a 24 bit (TBR) Second QA Data Plane. The first eight bits (which are common to both the Surface Kinetic Temperature and the Surface Emissivity products) are divided into four fields assigned as follows:

1	2	3	4	5	6	7	8
E_MAX		Number of Iterations		Sky Irradiance / Land-Leaving Radiance		E_MIN reset flag	unassigned

where

- E_MAX is the emissivity value for the channel with the maximum emissivity, categorized as follows:

Binary Value	E_MAX
00	TBD < E_MAX < TBD
01	TBD < E_MAX < TBD
10	TBD < E_MAX < TBD
11	E_MAX < TBD

- Number of Iterations is the number of iterations required for the algorithm to converge on the reported emissivity, categorized as follows:

Binary Value	Number of Iterations (N)
00	TBD < N < TBD
01	TBD < N < TBD
10	TBD < N < TBD
11	N < TBD

• Sky Irradiance/Land-Leaving Radiance is an indicator of the confidence in the reported value, higher ratios resulting in lower confidence. This ratio is categorized as follows:

Binary Value	Ratio (R)
00	TBD < R < TBD
01	TBD < R < TBD
10	TBD < R < TBD
11	R < TBD

• E_MIN Reset Flag is a binary flag that indicates whether the emissivity fell below a pre-assigned minimum value, and was then reset to equal that minimum value. If the bit is set it indicates that this occurred.

The remaining 16 bits (TBR) indicate the error status for each band. Each band is assigned three (TBR) bits as follows:

Binary Value	Errors Detected
000	No problems detected
TBD	E is bad due to out-of-range or other causes
TBD	Input Land-Leaving Radiance or Sky Irradiance were bad in input product
TBD	Input Land-Leaving Radiance or Sky Irradiance were suspect in input product
TBD	Additional errors are TBD

6.5 Surface Kinetic Temperature

This product has a 16 bit Second QA Data Plane. The first eight bits are common to both the Surface Kinetic Temperature and the Surface Emissivity products and are described with Surface Emissivity.

The second eight bits are divided into three fields as follows:

9	10	11	12	13	14	15	16
Accuracy		Precision		Band Used for Calculating Temperature			unassigned

where

- Accuracy is the binned, absolute accuracy of the reported value, in degrees K, so that the actual value is within A degrees K of the reported value. Accuracy is categorized as follows:

Binary Value	Accuracy (A), K
00	A < 1.0
01	1.0 < A < 1.5
10	1.5 < A < 2.0
11	A > 2.0

- Precision is the calculated precision based on the uncertainty of the inputs provided to the algorithm, and has the following bit assignments:

Binary Value	Precision (P), K
00	P < 1.0
01	1.0 < P < 1.5
10	1.5 < P < 2.0
11	P > 2.0

- Band Used for Calculating Temperature is the band whose emissivity value was used to calculate the reported surface temperature. It has the following bit assignments:

Binary Value	Band Used
000	Band 10
001	Band 11
010	Band 12
011	Band 13
100	Band 14
101	unassigned
110	unassigned
111	unassigned

6.6 Polar Surface and Cloud Classification

The Polar Surface and Cloud Classification product classifies each good pixel into one of 10 classes or as unknown. During the classification process it also derives a crude measure of confidence in the classification of each pixel. Because the confidence information is embedded into the classification encoding, this product does not have a separate First or Second QA Data plane. As an aid to understanding the confidence information, the classification encoding is presented below:

Encoding	Class
0,10,20,30	water
1,11,21,31	wet ice/slush
2,12,22,32	ice/snow
3,13,23,33	thin cloud over ice/snow
4,14,24,34	thin cloud over water
5,15,25,35	thin cloud over land
6,16,26,36	thick cloud
7,17,27,37	land
8,18,28,28	shadow on ice/snow
9,19,29,39	shadow on land

Thus, for example, an encoding value of either 0, 10, 20, or 30 indicates water. The particular value used indicates the confidence in the classification, lower values corresponding to lower levels of confidence, as follows:

Encoding Value	Confidence
0-9	Low. The spectral features were highly ambiguous between at least two classes; there is a significant probability that the pixel is misclassified.
10-19	Medium low
20-29	Medium high
30-39	High. The spectral features were unambiguous and the algorithm has high confidence in the classification result.

The confidence measure is derived primarily from metrics in the algorithm but also can be augmented by comparisons with ancillary data sources (such as MODIS and DAO). Due to a lack of representative scenes and samples, currently these certainty measures do not have a statistical basis. For example, the metric provided by the algorithm has not been tested in a contingency table using a chi square test. However, as more scenes are acquired, the results of a statistical analysis will be incorporated into the certainty measures.

Note: The format of this product is under revision; the revised product will have a format more similar to that of the other ASTER products.

6.7 Digital Elevation Model

This product has an eight bit Second QA Data Plane which contains the correlation coefficient between the two stereo channels (3N and 3B). The correlation coefficient, which ranges from 0.0 to 1.0, will be scaled from 0 to 255 to utilize the full dynamic range of the eight available bits.